70-1257

XN-2

Issue Date:

APPLICATION FOR RENEWAL

OF

SPECIAL NUCLEAR MATERIAL LICENSE NO. SNM-1227

(NRC DOCKET NO. 70-1257)

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SEPTEMBER 1986

EXXON NUCLEAR COMPANY, INC.

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FORWARD

This document, XN-2, Revision 13, revises document XN-2 in its' entirety and incorporates all previously submitted amendment applications and license amendments as appropriate and valid into a single licensing application document. In certain instances, previous submittals are incorporated by reference. This document is divided into two parts. Part I contains the proposed license conditions which are performance requirements to which the licensee proposes to commit. Part II contains detailed information demonstrating the applicant's capability to adhere to the license conditions as specified in Part I, but are not in themselves conditions of license.

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PART I

LICENSE CONDITIONS

CHAPTER I

STANDARD CONDITIONS AND SPECIAL AUTHORIZATIONS

CHAPTER 1 STANDARD CONDITIONS AND SPECIAL AUTHORIZATIONS

1.1 Corporate Information

The name of the applicant is Exxon Nuclear Company, Inc. (ENC). The applicant is a corporation incorporated in the State of Delaware with its principal corporate offices located at 600 108th Avenue N.E., Bellevue, Washington 98009. Applicant is a wholly-owned subsidiary of Exxon Corporation, a corporation incorporated in the State of New Jersey. The fuels fabrication plant for which this application is being made is located at 2101 Horn Rapids Road, Richland, Washington 99352.

1.2 Site Location

The fuels fabrication facility is located in the State of Washington, County of Benton, City of Richland. It is sited on a 320 acre tract, 0.9 miles west of the intersection of Stevens Drive and Horn Rapids Road within the north boundary of the City of Richland. The site is on the south side of Horn Rapids Road which provides access.

All activities with special nuclear materials are conducted within a controlled access area. The processing of uranium compounds is conducted primarily within the UO_2 and Speciality Fuels (SF) facilities with some development activity or pilot scale work in the Engineering Laboratory. Liquid waste processing is conducted primarily in the ammonia recovery facility and lagoon uranium recovery facility which are sited within the waste storage lagoon area. Solid waste is packaged in the various facilities and stored in containers in designated storage areas while awaiting shipment to a low level radioactive waste disposal site or incineration of the combustible waste in the SF Building. Storage of various uranium compounds is conducted in the various production facilities or in the Packaged Radioactive Materials Warehouse and Materials Warehouse. Storage of UF_6 cylinders is conducted outside on pads adjacent to the UO_2 plant and packaged fuel elements or other uranium products are stored outside or in a warehouse while awaiting shipment.

1.3 License Number and Period of License

1.3.1 Special Nuclear Materials License

This application is for renewal of Special Nuclear Material License No. SNM-1227 (NRC Docket No. 70-1257). The current license expires on October 31, 1986 and renewal is requested to cover a period of five (5) years.

PART I - LICENSE CONDITIONS | REV.

1.3.2 Source and By-Product Materials License

Licensing for receipt, possession, use and transfer of by-product and source materials is with the Washington State Department of Social and Health Services. The State license number is WN-1062-1.

1.3.3 Liquid Waste Discharge

The discharge of nonradioactive chemicals in liquid waste is regulated by Waste Discharge Permit No. 3919 issued by the Washington State Department of Ecology.

1.4 Possession Limits

1.4.1 Uranium-235 (20,000 Kilograms)

1. One hundred grams of any enrichment or form for analytical purposes.

2. Two hundred kilograms contained in uranium compounds enriched to a maximum of 19.99 wt% in the U-235 isotope (see Section 1.6.2 for restrictions).

3. The balance shall be contained in uranium compounds in any form enriched to a maximum of 5 wt% in the U-235 isotope.

1.4.2 Plutonium (<500 grams)

1. One milligram and not more than 1.5 millicuries as contained in sealed sources and standards.

2. Less than 500 grams as PuO_2 or PuO_2-UO_2 as stored waste.

1.5 Authorized Activities

Specific locations of authorized activities involving special nuclear materials are identified in Table 1-1.1.

1.6 Exemptions and Special Authorizations

1.6.1 Criticality Accident Alarm System Exemption

Pursuant to 10 CFR 70.24(d), Exxon Nuclear has previously requested exemption in part from the requirements of 10 CFR 70.24(a), and has been duly authorized to use the criticality accident alarm system described below in its facilities. In addition, the waste storage lagoons have been exempted from coverage by the criticality accident alarm system.

PART I - LICENSE CONDITIONS | REV.

The criticality accident alarm system used in the Exxon Nuclear facilities employs neutron criticality detectors (NCDs), which are operated in two-out-of-n (where n = 3 to 6 per comparator panel) coincidence to minimize the possibility of spurious trips due to NCD malfunction or response to radiation other than neutrons characteristic of a criticality accident.

The Exxon Nuclear criticality accident alarm system consists of NCDs, comparator units, associated control panels, an annunciator panel, and howlers. Each comparator unit is capable of monitoring the failure and trip signals of up to six NCDs.

Each NCD consists of a BF_3 tube (externally moderated) with associated pulse amplifiers, trip circuits, performance audit circuits, and associated power supplies.

Failure audit circuits check the operation of each BF_3 tube, pulse amplifier, multivibrator, and low and high voltage supplies by requiring a minimum background count rate of 100 counts per minute. This background count rate is provided by an internal radiation source in each BF_3 tube. If the minimum background is not detected by the audit circuit, a failure (indicating malfunction) is signaled. Such failure signals do not interfere with operation of the criticality accident alarm system.

Because the trip circuitry is not audited, redundant trip circuits are provided in each NCD. Failure and trip signals from all NCDs are fed to comparator units. Redundant trip detection is provided in the comparator units. The comparator panels display all failure and trip signals. When two or more NCDs connected to the same comparator unit are tripped, the criticality accident alarm (howlers) is activated.

An annunciator unit monitors the status of the comparator units, and an audible alarm is actuated in the Central Guard Station in the event that the annunciator unit detects either a failure or trip signal.

The minimum detectable criticality burst width for the Exxon Nuclear criticality accident alarm system is 50 microseconds.

An overall system reliability test is conducted quarterly.

The trip point of each NCD is set to trip within 1-5 seconds at 80 mrem/hr (fast neutrons).

The neutron dose rate delivered through 12 inches of concrete to an NCD at 300 feet as a result of a minimum burst of 10^{14} fissions (taken as the minimum criticality accident which must be detectable) has been calculated to be approximately 350 mrem/hr.

Except for the waste lagoons which have been exempted from coverage by the criticality accident alarm system, all special nuclear material at the Exxon Nuclear plant shall be located such that a criticality accident of 10^{14} fissions occurring in the material would produce a minimum of 350 mrem/hr at a set of three NCDs, considering distance and intervening shielding materials.

1.6.2 Special Processing of Uranium Enriched From 5 to 19.99 wt% U-235

Uranium compounds enriched in the U-235 isotope in excess of 5 wt%, but not exceeding 19.99 wt%, may be received, stored, processed and transferred.

All License Conditions described in this appliation shall apply to the handling, processing and storage of these materials. However, in addition, the Special Conditions described below shall also apply.

1.6.2.1 Receipt and Storage

These materials shall be received on-site and stored in containers distinctly different (e.g., size, color) from those routinely used for uranium enriched in the U-235 isotope to less than or equal to 5 wt%.

Containers of these materials, including scrap and contaminated solid wastes, shall be labeled identifying the enrichment and form, and shall be stored separate from (not comingled with) uranium enriched in the U-235 isotope to less than or equal to 5 wt%.

1.6.2.2 Processing

These materials shall be handled and processed on a safe batch (less than or equal to 45% of the minimum critical mass) basis, and each processing station shall be limited to an inventory of one safe batch, regardless of material form, unless it is demonstrated that:

1. Existing equipment and/or vessels to be used are shown to be adequately subcritical, for the special enrichment uranium to be processed, in accordance with criticality safety analysis methods described in the License Conditions; or

2. Existing equipment and/or vessels can be appropriately modified or replaced to conform to criticality limits, for the special enrichment uranium to be processed, established in accordance with criticality safety methods described in the License Conditions.

In all cases, appropriate labels shall be located with the material to identify it as special enrichment uranium. These materials shall be segregated from other fissile materials throughout the process.

1.6.2.3 Enrichment Blending

Some of these materials may be used to adjust the enrichments of uranium less than or equal to 5 wt% U-235. The rules on segregation of materials by enrichment obviously cannot apply to the blending operation; however, the blending operation will be subject to a criticality safety analysis and a Criticality Safety Specification.

Isotopic analysis shall be performed on each batch of blended material to assure that it is less than or equal to 5 wt% U-235. The blended material shall be handled as for the highest enrichment input to the blend until an isotopic analysis is obtained.

1.6.3 Plutonium Storage

Exxon Nuclear is presently in possession of plutonium, as PuO_2 and PuO_2-UO_2. This material is in the form of contaminated solid waste stored in drums.

These containers shall be stored in the SF Building storage vault in accordance with the following controls:

1. These stored containers shall be sealed with gaskets.

2. The SF Building storage vault shall continue to be exhausted by the building HVAC system. Two stages of HEPA filtration are provided prior to exiting the exhaust stack.

3. The air exiting the SF Building storage vault shall be continuously monitored and sampled, and the samples analyzed weekly for radioactive material content.

   Assurance of containment shall be verified at least once every six months by visual inspection and smear survey of the stored waste drums. The inspection and surveys will be documented. All indications of drum leakage will be investigated and appropriate action taken.

4. In order to provide continued containment, Exxon Nuclear may find it necessary to repackage the containers. These activities shall be performed using a special RWP.

5. All alpha discovered by smear surveys or air sampling within the vault area shall be considered as plutonium alpha unless proven otherwise.

1.6.4 Posting Exemption

All areas in which radioactive materials are stored, handled or used shall be posted with signs meeting the requirements of Title 10, CFR Part 20.203, except that of 20.203(f). In lieu of 20.203(f) requirements, a sign bearing the legend, "Every container or vessel in this area, unless otherwise identified, may contain radioactive material," may be posted at entrances to each building in which radioactive materials are used, stored or handled.

1.6.5 Waste Disposal

Disposal of solid waste material containing 30 pCi/gram or less to other than a licensed waste disposal facility is authorized. The low enriched uranium shall not exceed 30 pCi/gram of dry solid waste material. The uranium shall be essentially uniformly distributed throughout the waste material.

1.6.6 Special Nuclear Material Safeguards

Specific safeguards requirements for special nuclear material are given in Safeguards Amendment SG-1 issued pursuant to 10 CFR Parts 70, 73, 74 and 75. Those conditions are not affected by this licensing action.

1.6.6.1 Physical Security

Exxon Nuclear shall follow the special safeguards conditions given in the Safeguards Amendment SG-1 and the NRC approved security plan submitted in accordance with the provisions of 10 CFR Part 73.67(c)(1). The NRC approved security plan is:

1. XN-NF-538, "Physical Protection Plan for Material of Low Strategic Significance." This document shall be maintained in a current and approved status and shall be properly implemented.

1.6.6.2 Material Control and Accounting

Exxon Nuclear shall follow the special safeguards conditions given in the Safeguards Amendment SG-1 and the NRC approved Fundamental Nuclear Material Control Plan (FNMC) submitted in accordance with 10 CFR Part 70.22(b). The NRC approved FNMC Plan is:

PART I - LICENSE CONDITIONS	REV.

1. XN-12, "Nuclear Material Safeguards Procedures Description for the Fuels Fabrication Plant," (through Revision 15). This document shall be maintained in a current and approved status and shall be properly implemented.

In accordance with the provisions of 10 CFR 74.31(b)(1), Exxon Nuclear has also submitted a Fundamental Nuclear Material Control Plan (XN-12, Revision 16) for NRC review and approval. Upon NRC approval, this document will be followed and will replace the FNMC Plan for Part 70.

PART I - LICENSE CONDITIONS
Table I-1.1 Specific Locations of Authorized Activities

REV.

Location	SNM	Authorized Activity
SF Bldg.	Pu & PuO_2-UO_2 contaminated waste	Storage and repackaging.
	UO_2 (up to 19.99 wt% U-235)	Storage, blending, pressing, sintering, fuel rod loading and downloading, fuel rod welding, fuel element assembly; process tests; associated quality control activities.
	Uranium Compounds (up to 5 wt% U-235)	Waste storage, sorting, incineration, packaging and associated quality control activities.
UO_2 Bldg. (including Powder Storage)	Uranium Compounds (up to 5 wt% U-235)	All operational steps of fuel manufacturing from UF_6-UO_2 conversion to packaging finished fuel elements, scrap recycling and reprocessing; process tests; associated quality control activities.
	UO_2 (5 to 19.99 wt% U-235)	All operational steps of fuel manufacturing involving UO_2; including associated quality control activities.
ELO Bldg.	Uranium Compound (up to 19.99 wt% U-235)	All operational steps of fuel manufacturing involving uranium compounds; including process tests.
FCTF Bldg.	UO_2 (up to 5 wt% U-235)	Hydraulic flow tests involving single fuel elements.
Packaged Radioactive Materials Storage Bldg.	Uranium Compounds (up to 5 wt% U-235)	Storage of closed, and externally free of significant contamintion containers of product, scrap and waste materials.

PART I - LICENSE CONDITIONS
Table I-1.1 Specific Locations of Authorized Activities (Cont'd)

REV.

Location	SNM	Authorized Activity
Materials Warehouse	UO_2 (up to 5 wt% U-235)	Storage of closed and externally free of significant contamination containers of product, scrap and waste materials.
Laundry Facility	Uranium Compounds (up to 5 wt% U-235)	Cleaning of contaminated protective clothing and equipment.
UF_6 Cylinder Storage Areas	UF_6 (up to 5 wt% U-235)	Outside storage of UF_6 cylinders (full and empty).
Packaged Fuel Storage Areas	UO_2 (up to 19.99 wt% U-235)	Outside storage of fuel packed for shipment; the transport containers are closed, sealed and properly labeled for shipment.
Packaged Waste Storage Areas	Uranium Compounds (up to 19.99 wt% U-235)	Outside storage of contaminated materials which are packaged, sealed, labeled and externally free of contamination.
Process Chemical Waste Storage Lagoon System	Uranium Compounds (up to 5 wt% U-235)	Transfer, mixing, sampling, storage and solar evaporation of contaminated liquid wastes.
Retention Tanks	Uranium Compounds (up to 5 wt% U-235)	Interim storage of potentially contaminated liquid wastes.
High Uranium Solids Pond	Uranium Compounds (up to 5 wt% U-235)	Transfer of uranium bearing solids, leaching for uranium recovery.
Solids Trench	Uranium Compounds (up to 5 wt% U-235)	Transfer and storage of contaminated solids awaiting leaching or burial.
Lagoon Uranium Recovery	Uranium Compounds (up to 5 wt% U-235)	Recovery of uranium from waste solutions.
Ammonia Recovery Facility	Uranium Compounds (up to 5 wt% U-235)	Removal and recovery of ammonia from uranium contaminated liquid wastes.

CHAPTER 2

ORGANIZATION AND ADMINISTRATION

CHAPTER 2 ORGANIZATION AND ADMINISTRATION

The President of Exxon Nuclear Company, Inc., has the ultimate responsibility for ensuring that all Company operations are conducted safely and in full compliance with applicable Federal, State and local regulations, licenses and permits.

The Vice President, Engineering and Production has the overall responsibility for the safe operation of the plant. He is supported by the professional expertise residing in various segments of the organization. The relationship of those segments of the organization which contain a significant safety or licensing responsibility is depicted in Figure I-2.1. The division of responsibilities among the components described below has been carefully determined to provide a check and balance system in the important area of plant safety.

2.1 Organizational Responsibilities and Authority

2.1.1 President and Chief Executive Officer

In connection with his ultimate safety responsibility, the President shall assure that adequate manpower, funding and resources are made available within the company to achieve the capabilities committed in this Application. Additionally, he is responsible for assuring that safety philosophy is consistent throughout the Company.

2.1.2 Vice President, Engineering and Production

All facilities located at Exxon Nuclear's Richland, Washington, nuclear fuels plant are under the direction of the Vice President, Engineering and Production, who reports to the President of the Company. The Vice President, Engineering and Production, carries the responsibilities of the senior site representative.

The Vice President, Engineering and Production, is responsible for the overall management of the fabrication of nuclear fuels. Within this responsibility are the safety-related functions of operations, process and equipment engineering, transportation, maintenance, materials handling and storage, licensing, and industrial, radiation and criticality safety.

2.1.3 Manager, Operations-Richland

The operation of the nuclear fuel manufacturing and ancillary facilities at the plant are directed by the Manager, Operations-Richland, who reports to the Vice President, Engineering and Production.

The Manager, Operations-Richland is responsible for the fabrication of nuclear fuels within the constraints imposed by product, process, quality assurance, licensing and safety requirements. His responsibilities include plant operations, quality control, laboratories, maintenance, plant security, and industrial, radiation and criticality safety. He has the full authority required to discharge his responsibilities for safe operation of all site manufacturing facilities.

2.1.4 Manager, Plant Operations

The operation of the fuel manufacturing facilities are directed by the Manager, Plant Operations, who reports to the Manager, Operations-Richland.

The safe operation and control of plant activities, including the safety of the environs as influenced by the conducted activities, are the responsibility of the Manager, Plant Operations. Other responsibilities include:

1. Preparation of detailed work and operating procedures and training of employees for activities under his direction.

2. Compliance with license conditions and any required corrective actions resulting from either Exxon Nuclear or NRC compliance inspections.

3. Supervision of all manufacturing activities within the respective plants.

4. Special nuclear materials safeguards control and protection for activities under his management.

5. Membership in the Emergency Cadre.

6. Membership in the ALARA Committee.

The Manager, Plant Operations, has the full authority required to discharge his responsibilities for safe operation of his plant.

2.1.5 Manager, Process and Equipment Engineering

Radioactive materials licensing and all engineering activities to provide maintenance engineering, methods engineering, process engineering, and design and construction of new or modified equipment and facilities are directed by the Manager, Process and Equipment Engineering, who reports to the Vice President, Engineering and Production.

He is responsible for the adequacy of the health physics, criticality safety, environmental, safeguards, and compliance auditing programs. He is also responsible for providing process specifications to establish limits wherein the fuel fabrication process can be operated, for providing design criteria and engineering change notices which specify the bases required for the design and construction of new or modified equipment and facilities, and for providing manufacturing engineering support to the nuclear fuels fabrication plant. The latter activity includes maintenance engineering (to establish preventative/routine maintenance and instrument and equipment calibration requirements), methods engineering (to provide industrial engineering and product fabricability), equipment engineering (to implement the use of new and modified equipment) and process engineering (to provide process support and development).

He has the full authority required to assure that new or modified facilities are designed and constructed to operate within licensing and safety requirements.

2.1.6 Manager, Facilities and Equipment Engineering

Facilities and Equipment Engineering activities are directed by the Manager, Facilities and Equipment Engineering, who reports to the Manager, Process and Equipment Engineering.

The Manager, Facilities and Equipment Engineering is responsible for the design and/or modifification of new and existing equipment and facilities, for Maintenance Engineering, for Methods Engineering, for Equipment Development, and for Design and Drafting Support for all of Engineering and Production Division.

He is also responsible for establishing preventative maintenance; routine maintenance; routine equipment inspection; instrument calibration schedules, procedures, and equipment; and instrument and system testing programs for all plant facilities and operations. This includes equipment and systems installed to maintain personnel exposures to radiation and radioactive materials, as well as releases of radioactive materials to the environment, as far below the limits specified in 10 CFR 20 as is reasonably achievable. Radiation protection instruments and equipment, the criticality accident and fire alarm systems, and the electrical power emergency generators are included in these programs.

2.1.7 Manager, Chemical and Ceramic Development

The Manager, Chemical and Ceramic Development is responsible for process development activities for new and improved chemical and ceramic processes for preparing UO_2 and for treating liquid and solid wastes. These activities are conducted within licensing and safety requirements.

2.1.8 Manager, Process Support Engineering

Process Engineering activities are directed by the Manager, Process Support Engineering, who reports to the Manager, Process and Equipment Engineering.

The Manager, Process Support Engineering, is responsible for providing process engineering support to the fuel fabrication plant. This includes the preparation of process parameter operating limits and process specifications. He provides technical support for welding operations and for developing improved welding methods. These activities are conducted within licensing and safety requirements.

2.1.9 Manager, Equipment and Maintenance Engineering

Plant engineering assistance for all process, utility and safety systems is provided by the Manager, Equipment and Maintenance Engineering, who reports to the Manager, Facilities and Equipment Engineering. His areas of responsibility include the following:

1. Maintenance and calibration programs for radiation protection instruments and equipment.
2. Fire detection and alarm system.
3. Combustible gas detection and alarm systems.
4. Criticality accident alarm system.
5. Security alarm systems.
6. Plant engineering programs for HVAC systems.
7. Electrical power distribution systems.
8. Site water distribution and effluent services.
9. Developing and implementing preventative maintenance programs for process equipment.
10. Process equipment.
11. Pressure vessels.
12. Cranes and hoists.

2.1.10 Manager, Materials Research

The operation of the Engineering Laboratory Operations facility is directed by the Manager, Materials Research, who reports to the Manager, Fuel Research and Development.

The safe operation and control of facility activities, including the safety of the environs as influenced by the conducted activities, are the responsibility of the Manager, Materials Research.

Other responsibilities include:

1. Preparation of detailed work and operating procedures and training of employees for activities under his direction.

2. Compliance with license conditions and any required corrective actions resulting from either Exxon Nuclear or NRC compliance inspections.

3. Supervision, planning and controlling all activities involving radioactive materials within the Engineering Laboratory facility.

4. Special nuclear materials safeguards control and protection for activities under his management.

5. Membership in the Emergency Cadre.

The Manager, Materials Research, has the full authority required to discharge his responsibilities for safe operation of his facility.

2.1.11 Manager, Plant Maintenance

All plant maintenance activities are directed by the Manager, Plant Maintenance, who reports to the Manager, Operations-Richland.

In addition to common maintenance activities, the Manager, Plant Maintenance, is responsible for conducting established preventative maintenance and routine inspection programs for all safety related equipment and systems. He schedules maintenance activities with Manager, Plant Operations, and he is responsible for alerting the plant management of deteriorating and/or substandard conditions of safety-related equipment and systems.

He is responsible for maintaining and calibrating radiation protection instruments and equipment, the criticality accident alarm system and the fire detection and alarm system in accordance with established programs. He is also responsible for conducting tests of safety and emergency-related equipment as required by established programs.

He is a member of the ALARA Committee.

2.1.12 Manager, Safety and Security Operations

The Manager, Safety and Security Operations, reports to the Manager, Operations-Richland, and he is responsible for providing auxiliary services to all operations at the Richland Plant. These responsibilities include the following services:

1. Radiological safety support, through the services of the Supervisor, Radiological and Industrial Safety and Health Physics Technicians, as necessary to assure safe operation of facilities.

2. Industrial safety and hygiene support through the services of industrial safety specialists.

3. Criticality safety support through the services of the Plant Criticality Safety Engineer.

4. Plant security through the services of the Manager, Security Operations, and a security guard force.

If the Manager, Safety and Security, judges any operation as unsafe, he has the authority to request management to shutdown the affected operation. In the event of disagreement between the line management and the Manager, Safety and Security, the operations shall be immediately shutdown and the issue promptly brought to the attention of the Vice President, Engineering and Production.

2.1.13 Supervisor, Radiological and Industrial Safety

The Radiological and Industrial Safety Supervisor, who reports to the Manager, Safety and Security Operations, directs the activities of the Health Physics Technicians and the Industrial Hygienist.

The general function of the radiological safety component is to provide information, advice, and assistance to the operating and engineering components such that personnel and environmental protection are maximized and to keep adequate records to properly document conditions. Specific responsibilities of the Radiological and Industrial Safety Supervisor include the following:

1. Administering the plant radiological safety programs and directing the activities of the Health Physics Technicians.

2. Establishing radiological safety programs in accordance with criteria and standards provided by the Health Physics Component of Corporate Licensing. Such programs include air sampling, contamination and radiation surveys, bioassay in-vivo examination, and associated records systems.

3. Reviewing established programs and evaluating effectiveness.

4. Providing radiological safety analysis of proposed operational changes or modifications.

5. Preparing Radiation Work Procedures.

6. Assisting in preparation of reports to regulatory agencies.

7. Auditing operations for compliance with regulatory criteria, license conditions, and Exxon Nuclear criteria.

8. Assisting in health physics and radiation safety training.

9. Membership in the Emergency Cadre.

10. Membership in the ALARA Committee.

If the Supervisor, Radiological and Industrial Safety, judges any operation as unsafe, he has the authority to request management to shutdown the affected operation. In the event of disagreement between line management and the Supervisor, Radiological and Industrial Safety, the operations shall be immediately shutdown and the issue promptly brought to the attention of the cognizant department manager.

2.1.14 Health Physics Technicians

The collection and accumulation of basic radiological data, along with providing routine radiation monitoring services, is conducted by Health Physics Technicians who report to the Supervisor, Radiological and Industrial Safety. Senior Health Physics Technicians may be assigned special duties, along with appropriate titles.

Health Physics Technicians carryout established programs and assist in initiating new or necessary programs; specific responsibilities shall include the following:

1. Providing radiation monitoring.

2. Collecting air and effluent samples.

3. Issuing and controlling personnel dosimeters.

4. Maintaining all records pertaining to personnel exposure, contamination and air surveys, sampling, inspections, tests, etc.

5. Inspecting operations and reporting violations of written radiation protection procedures.

6. Membership in the Emergency Crew.

7. Providing personnel decontamination.

8. Providing training in radiological safety.

2.1.15 Plant Criticality Safety Engineer

The Plant Criticality Safety Engineer, who reports to the Supervisor, Radiological and Industrial Safety, provides criticality safety engineering assistance to the Manager, Plant Operations, and other groups using special nuclear material.

If the Plant Criticality Safety Engineer judges any operation as unsafe, he has the authority to request management to shutdown the affected operation. In the event of disagreement between line management and the Plant Criticality Safety Engineer, the operations shall be immediately shutdown and the issue promptly brought to the attention of the cognizant department manager.

The Plant Criticality Safety Engineer's responsibilities include the following:

1. Preparing criticality safety specifications and limits based upon criteria and analyses provided by Corporate Licensing.

2. Auditing shop operations for compliance with posted criticality safety specifications and limits and general administrative controls.

3. Technical liaison for operations in matters of criticality safety and shipping and receiving of special nuclear material.

4. Assisting in criticality safety training of personnel.

2.1.16 Manager, Fuel Development and Testing

The operation of the Fuels Cooling Test Facility (ETF) (where reactor simulated flow tests, involving a single fuel element, are conducted) is directed by the Manager, Fuel Development and Testing, who reports to the Manager, Fuel Research and Development.

The Manager, Fuel Development and Testing, is responsible for the safe operation of the Fuel Cooling Test Facility within the constraints imposed by license conditions, Radiation Work Procedures and Criticality Safety Specifications.

2.1.17 Manager, Operations Planning and Scheduling

The nuclear material traffic activities for Exxon Nuclear's Richland, Washington facilities are directed by the Manager, Operations Planning and Scheduling who reports to the Manager, Materials and Scheduling.

The responsibilities of the Manager, Operations Planning and Scheduling, include the following:

1. Shipping, receiving and warehousing of nuclear materials.

2. Maintaining nuclear material transfer records.

3. Maintaining custodial control of nuclear materials and providing warehousing of nuclear materials not under the control of operations managers.

4. Assuring that plant inventories of nuclear materials do not exceed authorized possession limits.

The activities are conducted within the confines of licensing and safety requirements.

2.1.18 Manager, Corporate Licensing

The Manager, Corporate Licensing, has overall licensing and regulatory responsibility for Exxon Nuclear's fuel production and transportation activities. This includes responsibility for defining, developing and monitoring Exxon Nuclear's nuclear material safeguards program.

He reports to the Manager, Process and Equipment Engineering. By this relationship, Corporate Licensing is wholly independent, with no manufacturing responsibility, and has access to the upper management of the Company.

The Manager, Corporate Licensing, is responsible for developing, administering and auditing the licensing, health physics, criticality safety, environmental surveillance, ALARA and safeguards programs for all Exxon Nuclear facilities located at Richland, Washington.

If the Manager, Corporate Licensing, judges any operation as unsafe, he has the authority to request management to shutdown the affected operation. In the event of disagreement between line management and the Manager, Corporate Licensing, the operations shall be immediately shutdown and the issue promptly brought to the attention of the Vice President, Engineering and Production. Actions following from this authority are subject to review and approval solely by the President of Company.

2.1.19 Health Physics Component

There is a Health Physics Component within the Corporate Licensing organization.

The responsibilities of the Health Physics Component include the following:

1. Providing technical bases, criteria, and methods related to health physics.
2. Preparing Radiation Protection Standards.
3. Providing for outside sources for aid and special services related to health physics and emergencies.
4. Performing compliance inspections.
5. Membership in the Emergency Cadre.
6. Membership in the ALARA Committee.
7. Approving exceptions to whole body exposure limits, if required and justified.
8. Reviewing Radiation Work Procedures.
9. Providing professional advice and counsel concerning matters within his cognizance.

2.1.20 Criticality Safety Component

There is a Criticality Safety Component within the Corporate Licensing organization.

The responsibilities of the Criticality Safety Component include the following:

1. Providing technical bases, criteria, and methods related to nuclear criticality safety.

2. Preparing the Nuclear Criticality Physics Methodology document and the Criticality Safety Standards.

3. Providing criticality safety determinations for designs and procedures.

4. Providing professional advice and counsel concerning matters within his cognizance.

5. Membership in the Emergency Cadre.

6. Performing compliance inspections.

7. Approving Criticality Safety Specifications.

All determinations concerning nuclear criticality safety shall be reviewed by a second-party reviewer who shall be knowledgeable in the technical data and qualified in the techniques of criticality physics. Second-party reviews shall be arranged for by the Criticality Safety component and may be either from within the component or by an outside reviewer. All nuclear criticality safety calculations and reviews shall be documented and documents shall be held in permanent Company records. Calculational details, work sheets, etc., shall be held for a minimum period of six months following termination of the process or operation reviewed.

2.2 Personnel Education and Experience Requirements

Responsibilities and authorities of all line managers shall be provided in writing. Hiring of managers and key professionals in plant operations, health physics and nuclear criticality safety shall be subject to approval by the Vice President, Engineering and Production.

Typical professional requirements for personnel filling positions within organizational components of the Engineering and Production Division are outlined in Part II, Chapter 11. Specific requirements for those key safety professionals whose major responsibility is in a safety field are listed below.

2.2.1 Radiological and Industrial Safety Supervisor

The minimum qualifications shall be a B.S. degree in a technical field with five years' experience in radiation safety, or, in the absence of a degree, then ten years' experience shall be required.

2.2.2 Health Physics Technician

The minimum qualifications of certified Health Physics Technicians shall be a high school diploma with two years of radiation monitoring experience or four years of similar experience in lieu of a high school diploma. Health Physics Technicians shall complete a formal Exxon Nuclear training program or shall have had equivalent prior training; they shall become proficient in Exxon Nuclear radiological safety programs, criteria, specifications, procedures, and routines.

2.2.3 Plant Criticality Safety Engineer

The minimum qualifications of the Plant Criticality Safety Engineer shall be a B.S. degree in a technical field with three years' experience in nuclear activities, or an additional six years of similar experience in lieu of a B.S. degree. In either case, at least one year of this experience shall be in criticality safety application.

2.2.4 Manager, Corporate Licensing

The minimum qualifications of the Manager, Corporate Licensing, shall be a B.S. degree in a technical field with ten years' experience in the nuclear energy field, of which four shall have been in positions with nuclear safety responsibility.

2.2.5 Health Physics Specialist

The minimum qualifications of at least one member of the Health Physics Component shall be a B.S. degree in Science or Engineering with five years' experience in radiation protection, including at least two years of radiation protection experience allied with nuclear fuel fabrication.

2.2.6 Criticality Safety Specialist

The minimum qualifications of at least one member of the Criticality Safety component, as well as for each second-party reviewer, shall be a B.S. degree in Science or Engineering with at least two years of experience in nuclear criticality safety analysis.

2.3 Safety Review Committees

2.3.1 Health and Safety Council

Exxon Nuclear has established the Health and Safety Council which convenes monthly at Exxon Nuclear's fuel manufacturing plant in Richland, Washington, to review various aspects of the safety program, including:

1. Industrial safety practices and trends.
2. Radiological safety practices and trends.
3. Criticality safety practices and trends.
4. Adequacy of emergency planning and procedures (including results of tests and drills).
5. Overall safety awareness and attitude of employees, and programs for promoting improvements.
6. Unusual occurrences and accident investigations, including recommendations to prevent recurrences.

Membership of this Council includes:

1. Manager, Operations-Richland (Chairman).
2. Supervisor, Radiological and Industrial Safety (Secretary).
3. Manager, Safety and Security Operations (Agenda Coordinator).
4. Vice President, Engineering and Production and his staff.
5. Manager, Corporate Licensing.
6. Plant Criticality Safety Engineer.
7. Appropriate managers within the operations, engineering and licensing organizations.
8. Key safety engineers and specialists.

Designated members of the Council make monthly inspections of housekeeping and safety practices and report the findings to the Council at the monthly meetings. Findings are assigned to individuals for resolution and are held open until resolved.

2.3.2 ALARA Committee

An ALARA (As Low As Reasonably Achievable) Committee maintains awareness of trends in employee radiation exposure and radioactivity content of effluent releases. The membership of the Committee includes:

1. Manager, Corporate Licensing (Chairman).
2. Health Physics Specialist (Secretary).
3. Supervisor, Radiological and Industrial Safety.
4. Manager, Facilities and Equipment Engineering.
5. Manager, Safety and Security Operations.
6. Manager, Plant Maintenance.
7. Manager, Plant Operations.
8. Manager, Process Support Engineering.

The ALARA Committee shall convene at least semi-annually. The ALARA Committee shall issue a formal report at least annually to the Health and Safety Council reviewing employee exposures and effluent release data to determine:

1. Trends in personnel exposures and effluents.
2. If personnel exposures or radioactive effluents might be lowered under the concept of as low as reasonably achievable.
3. If equipment for effluent and exposure control is properly designed, used, maintained and inspected.

Their reports shall include review of required audits and inspections performed during the past year and review of the following data: employee external exposures, bioassay results, unusual occurrences, effluent releases, in-plant airborne radioactivity, and environmental monitoring.

2.4 Training

In addition to normal on-the-job training, employees are instructed in radiation protection and criticality safety requirements and procedures, industrial safety, fire protection and emergency procedures. The degree of training is commensurate with each employee's position in the Company (related to general and special responsibilities) and with the extent of the employee's

contact with radioactive and fissionable materials. Employee instruction is provided by personnel knowledgeable in the various training topics. All formal training is documented and records are maintained by the Safety and Security Operations.

2.4.1 Initial Training

Each employee is provided initial instruction adequate to allow him to safely start on-the-job training; they are provided the full instruction within two weeks after starting work. Prior to assignment to independent operation, each employee is required to have been instructed in radiation protection, criticality safety, and emergency requirements and procedures as appropriate to his position.

2.4.2 Followup Training

When changes are made in radiation protection, criticality safety controls (procedures, specifications, etc.), or in emergency procedures, each employee affected is promptly informed and properly instructed.

Safety topics are routinely discussed in monthly safety meetings. Additionally, each employee routinely working with special nuclear material receives annual refresher instruction as part of Exxon Nuclear's continuing program in radiation protection and criticality safety awareness. The effectiveness of this annual refresher training is determined by giving the employees a written examination and reviewing the correct answers to the questions at the end of the test.

2.4.3 Health Physics Technician Training

Health Physics Technicians are given special training related to their radiation protection assignment. Previous training is accepted if considered equivalent to the Exxon Nuclear training program. Despite previous acceptable training, the Health Physics Technicians are required to become proficient in Exxon Nuclear radiation protection and criticality safety programs, criteria, specifications, procedures and routines, as demonstrated by successfully passing an Exxon Nuclear certification examination within six months after employment as a Health Physics Technician.

2.4.4 Training Evaluations

Employee awareness of and conformity to safety requirements and procedures, as well as the effectiveness of safety training programs, shall be evaluated at least monthly by the Radiological and Industrial Safety Supervisor for radiation protection and by the Plant Criticality Safety Engineer for

criticality safety. These Exxon Nuclear staff members have the authority to require retraining of employees. These evaluations shall be documented along with actions required by them.

2.5 Operating Procedures, Standards and Guides

Exxon Nuclear conducts its business in accordance with a system of Standard Operating Procedures, Company Standards and Policy Guides. Exxon Nuclear is committed to controlling activities involving special nuclear materials in accordance with these approved written procedures, standards and guides. These documents are prepared, reviewed, revised, approved and implemented in accordance with the Approval and Responsibility Matrix (Figure I-2.2). Plant and facility managers are responsible for assuring compliance with all pertinent radiation protection and criticality safety procedures, specifications and practices within their respective facilities. Violations of radiation protection or criticality procedures or specifications which are of repetitive or serious nature are subject to disciplinary action.

The Radiological and Industrial Safety Supervisor is responsible for assuring that Health Physics Technician activities are conducted in accordance with established and approved procedures, methods and frequencies.

2.6 Internal Audits and Inspections

Audits and inspections are conducted to determine that plant operations are conducted in compliance with regulatory requirements, license conditions, and written procedures. These audits and inspections apply to radiation protection, criticality safety, hazardous chemical safety, fire protection, and environmental protection.

2.6.1 Radiation Protection

As part of their normal activities, the Radiological and Industrial Safety Supervisor and Health Physics Technicians make periodic inspections of all areas of the plant where radioactive materials are stored, processed, or otherwise handled. Detected infractions of radiation protection procedures, exposure controls and sound radiation protection practices are corrected on the spot as part of a continuing education effort in their field of expertise. Serious infractions and noncompliance with license conditions are documented and distributed to the respective facility management and to the Manager, Corporate Licensing.

The Health Physics Component of Corporate Licensing makes monthly audits of radiation protection practices and exposure controls. These audits are made in accordance with a written plan. Results of these audits are documented, including any recommended corrective actions, and distributed to

the respective facility management and to the Manager, Corporate Licensing. The Health Physics Component shall follow up on each detected discrepancy in subsequent audits until there is satisfactory resolution.

2.6.2 Criticality Safety

While performing their daily duties, Health Physics Technicians are alert for infractions of criticality safety specifications and limits. Detected infractions are communicated to the Plant Criticality Safety Engineer.

The Plant Criticality Safety Engineer conducts inspections at least monthly of areas containing special nuclear material for compliance with respective criticality safety specifications and limits, as well as with other safe practices. These inspections are performed in accordance with a written plan and reports of the findings are submitted to the respective facility management and to the Manager, Corporate Licensing. The Plant Criticality Safety Engineer shall follow up on each detected infraction in subsequent inspections until there is satisfactory resolution.

The Criticality Safety Component of Corporate Licensing conducts audits at least bi-monthly of the various criticality safety control systems, (e.g., moderation control, enrichment control, neutron absorber inspections, process alarms and trips related to criticality safety, etc.). The Criticality Safety Component also audits new installations and modifications to equipment and processes prior to their operation with special nuclear material. These audits are performed in accordance with a written plan and reports of the findings are submitted to the respective facility management and to the Manager, Corporate Licensing. The Criticality Safety Component shall follow up on each detected infraction in subsequent audits until there is satisfactory resolution.

2.6.3 Hazardous Chemical Safety

As part of their normal duties, the Radiological and Industrial Safety Supervisor and the Industrial Hygiene Specialist make periodic inspections of all areas of the plant where hazardous chemicals are stored, processed, or otherwise handled. Detected discrepancies of exposure controls and sound industrial hygiene practices are corrected on the spot as part of their continuing educational effort.

The Industrial Hygiene Specialist also monitors the levels of the various chemicals that are present on our plant site in accordance with a written Industrial Hygiene Monitoring Program plan. Results of these inspections are documented, including any recommended corrective actions, and distributed to the respective facility management and to the Manager, Safety and Security Operations. The Industrial Hygiene Specialist shall follow up on each detected discrepancy in subsequent inspections until there is satisfactory resolution.

2.6.4 Fire Protection

The Inspection Committee of the Richland Health and Safety Council performs monthly inspections of selected areas of the Richland facility. These inspections include housekeeping concerns as well as industrial safety concerns. A facility with good housekeeping (combustible wastes properly contained, emergency exits accessible and uncluttered, fire extinguishers properly maintained), will experience fewer and less serious fires. Results of these inspections are documented, including any recommended corrective actions, and distributed to the respective facility management. The Inspection Committee shall follow up on each detected discrepancy and recommended corrective action in subsequent inspections until there is satisfactory resolution.

The Radiological and Industrial Safety Supervisor ensures that a monthly inspection is made of all plant fire extinguishers in accordance with a written plan. Results of these inspections are documented and any detected discrepancies are corrected during the inspection.

2.6.5 Environmental Protection Inspections

The Industrial Hygiene Specialist monitors the levels of regulated material released to the environment in accordance with a written plan. The Health Physics Technicians are responsible for the field sampling under the guidance of the Industrial Hygiene Specialist. Results of this monitoring are documented and distributed to the Manager, Corporate Licensing.

The Health Physics Component of Corporate Licensing makes monthly inspections of environmental protection practices and exposure controls. These inspections are made in accordance with a written plan. Results of these inspections are documented, including any recommended corrective actions, and distributed to the respective facility management and to the Manager, Corporate Licensing. The Health Physics Component shall follow up on each detected discrepancy and recommended corrective action in subsequent inspections until there is satisfactory resolution.

2.7 Investigations and Reporting of Reportable Incidents

In addition to and/or in-line with the reporting requirements specified in other sections of this application or in Regulatory Guide 10.1, the following reporting schedule is adhered to:

1. Employee, former employee, or terminating employee radiation exposure information shall be reported to individuals in accordance with 10 CFR 19.13(b)(c)(e);

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2. Personnel exposure upon termination of employment or work shall be submitted to the NRC in accordance with 10 CFR 20.408(b) and 10 CFR 20.409;

3. Employee exposures and monitoring information shall be reported to the NRC in accordance with 10 CFR 20.407;

4. Over exposures and excessive levels and concentrations shall be reported to the NRC in accordance with 10 CFR 20.405(a) and 10 CFR 20.409;

5. The NRC shall be notified of incidents in accordance with 10 CFR 20.403(a)(b);

6. Theft or loss of licensed material shall be reported in accordance with 10 CFR 20.402(a)(b)(c);

7. Effluent monitoring information shall be reported to the NRC in accordance with 10 CFR 70.59;

8. In the event that the radioactivity in plant gaseous effluents exceeds 50 microcuries per calendar quarter, a report shall be submitted within 30 days to the NRC (Director, Office of Nuclear Material Safety and Safeguards, with a copy to NRC Region V Office of I&E), identifying the cause for exceeding this value and the corrective actions to be taken to reduce release rates;

9. If parameters important to dose assessment of the public relative to gaseous effluents from the plant change, a report shall be submitted to the NRC (Director, Office of Nuclear Material Safety and Safeguards, with a copy to NRC Region V Office of I&E) within 30 days identifying the changes in parameters and providing an estimate of the resultant change in dose commitment;

10. Reports of excessive radioactive contamination on packages of radioactive material and excessive radiation levels external to the packages on receipt shall be reported to the NRC immediately in accordance with 10 CFR 20.205(b)(2) and 10 CFR 20.205(c)(2);

11. Accident reports on transportation of licensed material shall be reported to the NRC and DOT in accordance with 10 CFR 71.5(b) and 49 CFR 171.15 and 49 CFR 171.16.

The Manager, Corporate Licensing, or Manager, Safety and Security, have the responsibility for investigating, recording, reporting, and following up on actions taken for reportable incidents in accordance with NRC reporting requirements.

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2.8 Records

In addition to and/or in-line with the documentation requirements specified in other sections of this application and 10 CFR 20.401, the following records are retained:

1. Personnel radiation exposure histories and determinations of personnel accumulated dose. (Information on personnel prior radiation exposure histories is obtained in accordance with 10 CFR 20.102(c)(1).)
2. Employee radiation exposures, external and internal, including dose evaluations.
3. Health Physics Technician's radiation and contamination surveys, including room air and exhaust air monitoring.
4. Environmental surveillance data and waste discharge reports.
5. Incident investigation reports.
6. Employee indoctrination, training and retraining reports.
7. Facility and process acceptance tests.
8. Radiation safety, health physics, and criticality safety inspection reports.
9. Richland Health and Safety Council meeting reports.
10. ALARA Committee reports.
11. Criticality dosimeter inspection reports.
12. Reports of test results for the criticality accident alarm system.
13. Reports of test results for the emergency electrical power supply system.
14. Radiation detection instrument maintenance and calibration; also for the neutron detectors of the criticality accident alarm system.
15. Results of sealed source leak checks.
16. HVAC system monitoring and test results.

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17. Engineering Change Notices (ECN).

18. Revisions to Nuclear Criticality Safety Analysis.

Such records are maintained for a minimum period of five years unless there are legal requirements for longer retention periods for specific records.

EXXON NUCLEAR COMPANY, INC.

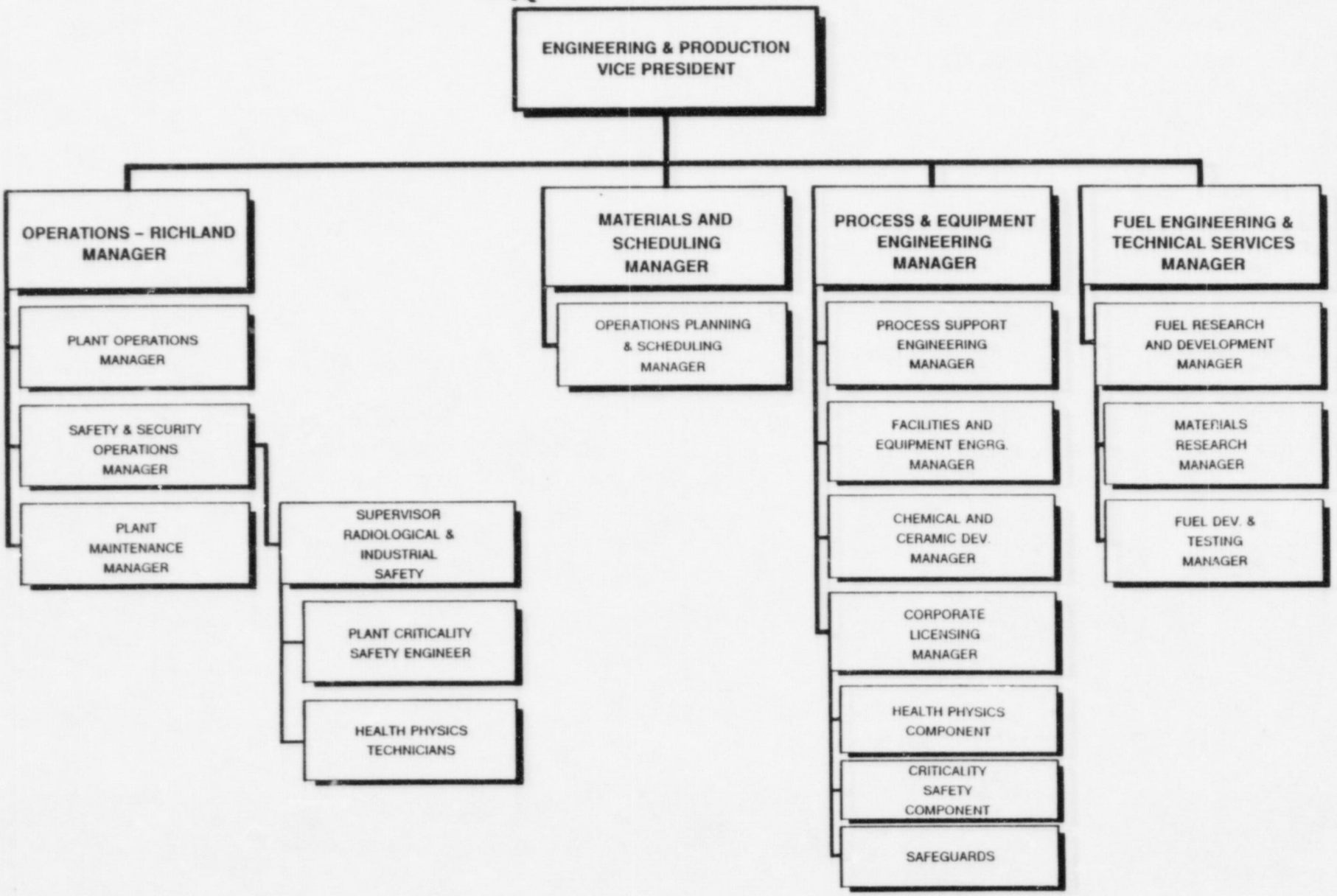

FIGURE I - 2.1

Figure 1-2.2 Approval and Responsibility Matrix

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A - Prepare/Initiate
B - Approve/Concur/Accept
C - Implement
D - Audit

A primed letter indicates functional responsibility limited to area of responsibility

	Vice-President, Engineering and Production	Manager, Operations-Richland	Manager, Plant Operations	Manager, Plant Maintenance	Manager, Quality Control	Manager, Safety and Security Operations	Supervisor, Radiological and Industrial Safety	Health Physics Technicians	Plant Criticality Safety Engineer	Industrial Hygiene Specialist	Manager, Materials and Scheduling	Manager, Operations, Planning and Scheduling	Supervisor Shipping and Warehousing	Manager, Process and Equipment Engineering	Manager, Corporate Licensing	Health Physics	Criticality Safety	Manager, Facilities and Equipment Engineering	Manager, Equipment and Maintenance Engineering	Manager, Process Support Engineering	Construction Engineer	Manager, Fuel Engineering and Technical Services	Manager, Fuel Research and Development	Manager, Fuel Development and Testing	Manager, Materials Research	
Radiation Protection Standards	B	B				B	C				B			B	B	A/D						B				
Radiation Safety Operating Procedures		B		C'		B	A	C							B	D			C'							
Radiation Work Procedures			B'/C'	C'	C'		A	D				B'/C'	C'			B/D					C'			B'/C'	B'/C'	
Nuclear Criticality Safety Criteria	B														B		A/C									
Nuclear Criticality Safety Analysis									C								A/C/D									
Nuclear Criticality Safety Standards	B	B				B			C		B			B	B		A/D					B				
Criticality Safety Specifications/Limits		B	B'/C'		C'				A/D			B'/C'	C'				B								B'/C'	
Environmental Safety Standards	B	B	C'	C'	C'	B	D	C'		C	B			B	B	A/D										
Industrial Safety Standards	B	B	C'	C'	C'	B	A			A/D	C'		C'	B/C'	B							C'				
Emergency & Radiological Contingency Plan	B	B	C'			A/C'	C'	C'							B	C	C									
Engineering Change Notice			B'	B	B'		B								B'	D'	D'	B	A'/B'	A'/B'	A'/B'			A'/B'	A'/B'	
Process Test Authorization		B	B		B		B				B'			B	B			B		A/B/C		B'				
Incident Investigations	A	A'/B'	A'/B'			A/B					A'/B'			A'/B'	A/B/D							A'/B'				
Training Programs		B'	A'/C'	A'/C'		D'	A'/C'	A'/C'	A'/C'	A'/C'						D'	D'								A'/C'	A'/C'	

CHAPTER 3

RADIATION PROTECTION

Chapter 3 RADIATION PROTECTION

3.1 Special Administrative Requirements

3.1.1 ALARA Policy

It is the policy of the Exxon Nuclear Company to conduct its business in a manner such as to assure that its facilities are in compliance with radiation and other nuclear regulations, and that its operations will not be detrimental to the environs. In implementing this policy, Exxon Nuclear shall assure that radiation exposure to persons (both in-plant and off-site) is maintained as low as reasonably achievable (ALARA). In providing this assurance, conditions of applicable NRC and State licenses and other regulatory permits or licenses shall be complied with and regard shall be given to applicable NRC regulatory guides and industry standards.

Responsibility for establishing and assuring adherence to this policy shall rest with the President, Exxon Nuclear Company, Inc. This policy shall be implemented through appropriate delegations to Vice Presidents responsible for facilities processing or otherwise handling radioactive and nuclear materials.

In order to facilitate implementation of this policy, key positions in organizations involved with facilities processing or otherwise handling radioactive or nuclear materials shall be filled by persons knowledgeable of, and experienced in, the nuclear industry, and the responsibilities under this policy shall be identified in writing. Each responsible manager shall be required to know, understand, and carry out the provisions of this policy and the procedures for its implementation.

3.1.2 Radiation Work Procedures

Radiation Work Procedures (RWP) are prepared by Radiological and Industrial Safety and establish the radiological safety requirements of all work (operation and maintenance) involving radiation and/or radioactive materials. The RWP shall be immediately available to personnel working with the material.

Radiation Work Procedures are approved in accordance with Figure I-2.2.

Radiation Work Procedures cover such items as:

1. The identification number of the procedure;

2. A description of the nature and extent of the work to be done and the location of the work;

3. A description of types and levels of radiation exposures and contamination that may be encountered;

4. A statement of the exposure rates or instructions for self-monitoring for exposure rates;

5. Personal survey requirements and protective clothing requirements;

6. Personal dosimetry requirements;

7. A statement of the respiratory equipment required for entry into an airborne radioactive materials area.

3.2 Technical Requirements

3.2.1 Controlled Areas

All radioactive materials at Exxon Nuclear's nuclear fuel fabrication plant are stored and processed within a controlled access area. Access is controlled by Exxon Nuclear security personnel at all personnel and vehicle entrances in accordance with a physical security plan.

3.2.1.1 Restricted Areas

Radioactive Material, airborne radioactivity, radiation and high radiation areas, as defined by 10 CFR 20, are identified and their boundaries are visibly marked. Signs are placed denoting these areas so that at least one sign is visible from any approach. Radiation Work Procedures for the respective areas specify the existing or potential conditions and the protection measures required in these areas.

3.2.1.2 Clean, Intermediate and Contaminated, Radioactive Materials/Radiation Areas

Noncontaminated Radioactive Material Areas (clean areas) are separated from the Contaminated Radioactive Material Areas (contaminated areas) by Intermediate areas. Intermediate areas are identified and their boundaries are visibly marked. Special restrictions or procedures required before entry to intermediate or clean areas from a contaminated area are posted.

3.2.1.3 Change Rooms and Step-Off Areas

Change rooms are divided into contaminated, intermediate and clean areas to facilitate controlled entrance to and egress from contaminated areas. Step-off pads are provided when exiting contaminated areas. Separate toilet facilities may be located in both the intermediate and clean areas of change rooms. Use of toilet facilities in the intermediate area without removal of protective clothing is permitted provided a personnel survey is first performed.

Additional step-off areas may be established for maintenance work, temporary situations or conditions, or to accommodate personnel entry and exit not requiring the use of change room facilities. Personnel survey requirements are adhered to at all step-off areas.

3.2.1.4 Protective Clothing

Protective clothing is required for entry into contaminated areas. The type(s) of clothing required is dependent upon the levels and types of contamination present and work assignment and is specified in the applicable radiation work procedure.

Appropriate respiratory protective equipment is required for entry into Airborne Radioactivity Areas. Such equipment is not used in lieu of proper ventilation or contamination control.

3.2.1.5 Personnel Surveys

Personnel working in contaminated areas are instructed to change their protective clothing if excessive contamination is detected. Personnel exiting from contaminated areas are required to survey themselves after removing their protective clothing to assure themselves that they are free of significant contamination prior to leaving the step-off areas. Emergency evacuation is the only exception to these survey requirements. Personnel survey instruments are located at step-off areas and radiation workers are trained in their use.

3.2.2 Ventilation

Ventilation systems are designed and maintained to limit the spread of airborne contamination by maintaining air pressure gradients and air flows from areas of low potential airborne contamination to areas of higher potential contamination. These systems are balanced so that air pressure differentials between general areas (non Radioactive Material Areas) and contaminated areas are maintained at a minimum of 0.05 inches of water.

Airlocks are provided between areas where necessary to insure maintenance of proper air pressure differentials. Installed differential air pressure measuring instruments are read routinely and the readings recorded at least monthly.

Periodic smoke tests are conducted to visually demonstrate that the air flows are in fact from areas of low contamination potential to areas of higher contamination potential.

The ventilation rate in contaminated areas is maintained at a minimum of seven air changes per hour.

The air velocity through openings in uranium handling hoods and equipment containing readily dispersible forms of uranium is maintained at a minimum of 125 linear feet per minute. These velocities are verified at least monthly.

Recirculating air systems are designed and maintained to supply air at concentrations not greater than respective values listed in 10 CFR 20, Appendix B, Table II, Column I. To insure this, recirculated air is taken only from room areas (not from process enclosures) and before being returned to work areas it is passed through fire-retardant HEPA filters which are assured to have installed efficiencies of at least 99.95% for 0.8 micron particles.

Recirculation air is continuously monitored prior to the final stage of HEPA filtration. An indication of eight MPC-hours will automatically divert the air from the recirculation mode to the respective facility exhaust air system.

Both recirculation air and exhaust air system HEPA filter installations are equipped with continuous pressure differential measuring/indicating systems, which are read and the readings recorded at least monthly. The differential pressure across final HEPA filters is not allowed to exceed four inches of water gauge.

3.2.3 Work Area Air Sampling

The air in all areas where uncontained radioactive materials are handled, processed or are likely to exist is regularly sampled, and the samples are analyzed for radioactivity. The air sampling system is a flexible combination of equipment and instruments. Field-run lines (flexible or hard-piped) connect individual air samplers to the overhead vacuum lines such that the samplers may be moved about and located at any desirable point without causing obstructions or creating industrial safety problems. Some samplers are located at points of maximum airborne contamination potential, some are located at points representative of the contamination level of air breathed by personnel at work stations, and some are located so as to provide background data.

Specialized air sampling or monitoring equipment such as continuous air monitors, portable high volume air samplers, and lapel air samplers are available to supplement the normal air sampling system and for use in studies or work on special problems.

The filter papers of the sampling units at work stations are exchanged and analyzed at least daily (Monday through Friday). Some samples may be exchanged and analyzed more frequently in the event of a known or suspected elevated airborne contamination, or to assess the effectiveness of radioactive material containment following equipment modification or maintenance, or to assess the air quality of sequential shift operations.

Permanently mounted air sampling equipment used to determine the concentrations at work stations shall be evaluated for representativeness at least every 12 months or following significant process or equipment changes.

The air flow rates through air samples, as measured by in-line rotometers, are checked at the start and at the end of each respective sampling period.

Air sample counting instruments are checked for proper operation each workday and background values are determined.

Personnel are not allowed into areas without adequate respiratory protection when the concentration of uranium in air samples exceeds 1×10^{-10} microcuries/ml.

3.2.4 Radioactivity Measurements Instruments

3.2.4.1 Radiation Safety Instruments and Equipment

The general capabilities of radiation safety instruments used to make radiation protection measurements are described in Table I-3.1.

The Manager, Plant Maintenance, is responsible for the maintenance and calibration of radiation safety instruments and equipment. The following general requirements apply to all such equipment and instruments:

1. All radiation detection instruments are inspected, repaired when necessary, and calibrated at least semiannually except for dose rate instruments which are calibrated quarterly..

2. Instruments are calibrated following any maintenance on them before they are put back into routine service.

3. Each on-line radiation detection instrument is checked for proper operation by Health Physics Technicians daily (Monday through Friday). When daily checks are performed in a manner which qualifies as calibration, separate semi-annual calibrations are not required.

4. Portable survey instruments are source checked each time they are turned on for use.

5. AC-operated personnel contamination survey instruments are provided with individual check sources to allow personnel to source check the instruments at random.

6. Calibration sources are traceable to the National Bureau of Standards.

3.2.4.2 Criticality Accident Alarm System

See Chapter I, Section 1.6.1.

3.2.4.3 Criticality Dosimeters

Criticality dosimeters are strategically located throughout the process facilities. These criticality dosimeters are capable of measuring 0.1 to 10^4 rem of neutron radiation over a neutron spectrum of thermal to 2.5 MeV. The criticality dosimeters are inspected at least annually to assure their integrity.

3.2.5 Radiation Exposure

Exxon Nuclear shall maintain external radiation exposures as far below the normal limits specified in 10 CFR 20.101(a) as is reasonably achievable. Radiation exposure records are reviewed by the ALARA Committee.

In the event that it is necessary to exceed the exposure limits specified in 10 CFR 20.101(a), exceptions will be authorized in accordance with 10 CFR 20.101(b). Respiratory protective equipment will be used for entry into areas where airborne radioactive materials exist in excess of the concentrations stated in 10 CFR 20, Appendix B, Table I, Column 1.

In addition to the controls specified elsewhere, the following methods of external radiation exposure control are employed as applicable and reasonable:

1. Automation of operations.

2. Minimization of quantities of radioactive material and/or use of shielding.

3. Time and distance control.

4. Special handling tools.

5. Exposure awareness, planning and scheduling.

3.2.5.1 Radiation Surveys

A detailed survey of radiation levels (β-γ and neutron, as applicable) is performed for each specific operation and radioactive material storage area as activity in the area is initiated.

Routine radiation surveys are performed at least monthly in all areas where radioactive materials are stored or processed, and where personnel have access.

Radiation surveys are performed on all incoming and outgoing shipments of radioactive materials per 10 CFR 20.

3.2.5.2 Dosimetry

All persons entering a radioactive materials area of the plant are required to wear β-γ sensitive dosimeters. The β-γ dosimeters are supplemented, as appropriate, by other types of dosimeters (i.e., finger rings, direct-reading dosimeters, and neutron dosimeters), and by radiation measurements made with radiation survey instruments.

Personnel dosimeters shall be capable of measuring the following radiation exposure ranges:

beta/gamma dosimeters: 10 mrem - 1000 rem

For personnel routinely working in areas containing radioactive materials, radiation exposure dosimeters (whole-body beta/gamma) are exchanged and analyzed quarterly.

3.2.6 Surface Contamination

Radioactive materials are contained and/or confined during processing, transfer and storage to the extent of maintaining intake of such materials by personnel as low as is reasonably achievable. As appropriate, operations involving readily dispersible forms of radioactive materials are accomplished within enclosures (i.e., process equipment, glove boxes, glove-port hoods, laboratory type hoods, etc.) which are exhausted to facility exhaust air systems.

3.2.6.1 Facility Surveys

The following minimum frequency schedule is applied to the facility contamination survey program:

Contaminated Radioactive Materials Areas:	Weekly
Noncontaminated Radioactive Material Areas:	Monthly
Intermediate Areas:	Daily
Lunch Rooms Adjacent to Radioactive Materials/Radiation Areas:	Daily

Action levels for clean up of the various areas are listed below.

1. Noncontaminated Radioactive Material Areas. These areas are to be kept contamination free. Any contamination in excess of background is to be cleaned up during the shift detected.

2. Intermediate Areas. These areas are to be kept free of significant contamination. Any contamination less than 500 dpm (alpha) per 100 cm^2 is to be cleaned up during the shift detected. Contamination in excess of 500 dpm (alpha) per 100 cm^2 is to be cleaned up immediately. If the contamination level is in excess of 2,000 dpm (alpha) per 100 cm^2, the area is reclassified as a contamination control area until it is cleaned up.

3. Contaminated Radioactive Material Areas. Visible contamination in these areas and/or smearable contamination in excess of 10,000 dpm (alpha) per 100 cm^2 will be cleaned up immediately. These limits are not applicable to nonroutine tasks being conducted under special controls.

4. Smearable contamination in outside areas is to be kept as far below 1,000 dpm (alpha) smearable and 5,000 dpm (alpha/fixed) per 100 cm^2 as possible.

5. Efforts are made as appropriate to decontaminate materials and personnel as far below the 5,000 dpm (alpha) fixed per 100 cm^2 and 1,000 dpm (alpha) smearable per 100 cm^2 limits as possible before releasing them.

3.2.6.2 Release of Personnel, Materials, Equipment, Facilities and Shipments

Contamination surveys are performed on all personnel leaving contaminated areas, on all materials, equipment and facilities to be released from radiation protection requirements, and on all incoming and outgoing shipments

of radioactive materials. Release of equipment and packages from the plant site or to clean areas on-site shall be in accordance with Annex C dated November 1976 (see Appendix A).

1. Personnel. Personnel contamination surveys are conducted according to the following schedule:

   a. All persons leaving contaminated areas are required to survey themselves for contamination with survey instruments located at respective step-off areas after removing protective clothing and prior to leaving the step-off area.

   b. Personnel are not released to eat or leave the respective facility if their personal clothing is contaminated in excess of the following limits, except with the approval of the Radiological and Industrial Safety Supervisor and the respective facility manager:

      Smearable: 200[1] dpm (alpha) per 100 cm^2
      Fixed Uranium: 2000 dpm (alpha) per 100 cm^2

   c. For routine release, personnel skin surface contamination shall not exceed 200 dpm (alpha) per 100 cm^2.

2. Materials, Equipment, Facilities and Shipments. Contamination surveys are performed by Health Physics Technicians on all materials and equipment removed from contaminated areas, and on areas or facilities to be released from radiation protection requirements.

3. Shipments of radioactive materials arriving at the facility are surveyed to the requirements of 10 CFR 20.205. All outgoing shipments of radioactive materials are packaged and surveyed in accordance with 10 CFR 71 and 49 CFR 173.443.

3.2.7 Bioassay Program

Bioassay measurements shall be conducted so as to assure compliance with 10 CFR 20.103 and the ALARA policy. The bioassay program will normally be used as a verification of contamination control, but may in accident or abnormal situations be used to estimate the uptake by an individual or estimate the exposure that an individual has or will receive. The normal bioassay program shall consist of a monthly urinalysis and yearly lung

1 200 dpm (alpha) per 100 cm^2 represents the practical lower detection level for most direct-reading contamination survey instruments.

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count. The lung counts shall be scheduled among the workers throughout the year (as possible) to provide a continuing status of the plant environment. Additional diagnostic assays may be performed on workers who have entered an airborne radioactivity area as indicated by air sampling results.

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Table I-3.1 Radiation Safety Instrument Capabilities

Type of Instrument	Radiations Detected	Range	Lower Detection Level
Air Sample Analyzers	α	0 - 10^6 cpm	1 cpm
Air Contamination Monitors	α	0-5x10^3 cpm	1 cpm
AC-Operated Survey Meters	α	0 - 10^6 cpm	20 cpm
Portable Survey Meters	α	0-5x10^5 cpm	20 cpm
Portable Survey Meters	β,γ	0-5x10^4 cpm	20 cpm
Portable Low Energy Dose Rate Survey Meters	β,γ,x	0 - 300 mR/hr	0.1 mR/hr
Portable Dose Rate Meters	β,γ,x	0 - 25 R/hr	0.1 mR/hr
		0 - 100 R/hr	0.1 mR/hr
		0 - 300 R/hr	0.1 mR/hr
		0 - 500 R/hr	0.1 mR/hr
Portable Dose Rate Meters	n	0 - 2 rem/hr	0.1 mrem/hr
Direct-Reading Dosimeters	γ,x	0 - 200 mR	-
	γ	0 - 10 R	-
	γ	0 - 600 R	-
	x,γ,n	0 - 200 mrem	-

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APPENDIX A

CHAPTER 3

ANNEX C

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U. S. Nuclear Regulatory Commission
Division of Fuel Cycle and
Material Safety
Washington, D.C. 20555

NOVEMBER 1976

The instructions in this guide in conjunction with Table I specify the radioactivity and radiation exposure rate limits which should be used in accomplishing the decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table I do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control will be considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table I prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table I. A copy of the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, D.C. 20555, and also the Director of the Regional Office of the Office of Inspection and Enforcement, USNRC, having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instruction.

Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES [a]	AVERAGE [b c f]	MAXIMUM [b d f]	REMOVABLE [b e f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except SR-90 and others noted above.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surfac area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

CHAPTER 4

NUCLEAR CRITICALITY SAFETY

CHAPTER 4 NUCLEAR CRITICALITY SAFETY

Nuclear criticality safety shall be assured through both administrative and technical practices. Administrative practices include establishing clearly the responsibilities for nuclear criticality safety, providing adequate and skilled personnel, preparing written standards and procedures, process analysis, materials and operational controls, operational and incident reviews, and emergency procedures. Technical practices include exercising control over the mass and distribution of significant quantities of special nuclear materials and the mass, distribution, and nuclear properties of all other materials with which special nuclear materials are associated.

4.1 Administrative Conditions

The responsibilities and authorities for nuclear criticality safety are as described in Section 2 of this application as well as the professional requirements for criticality safety personnel.

4.1.1 Process Analyses (Critically Safe Determinations)

Before any operation with special nuclear material is begun or changed, it is determined that the entire process will be subcritical under both normal and credible abnormal conditions, and within the technical requirements specified in Section 4.2. Criticality safety analyses are performed on all applicable processes in accordance with Section 2.1.20, and all determinations of nuclear criticality safety are reviewed and approved by a second-party reviewer in accordance with the requirements specified therein.

Criticality safety analyses are performed and/or reviewed by Exxon Nuclear or contractor personnel who meet the professional requirements specified in Section 2.1.20.

Records of criticality safety analyses of processes shall be documented and retained in accordance with Section 2.1.20. Additionally, basic criteria, data, methods and references pertaining to nuclear criticality safety shall be documented and retained in Company files by the Criticality Safety Component of Corporate Licensing.

Operations in which nuclear criticality safety is pertinent are governed by written procedures, and all persons participating in these operations are required to be familiar with the procedures. Each major process step is described by a written Process Specification which, together with the respective Criticality Safety Specification, provides the basis for written Operating Procedures.

Criticality Safety Specifications are prepared in a standardized format containing the following information: work location, equipment description, special nuclear material description (element, isotope, enrichment, form, density), operation involved, control limits, moderator and reflector restrictions, spacing restrictions, criticality safety procedures, date, and approvals.

Criticality Safety Specifications are maintained up-to-date and reflect all approved process and/or equipment changes. Additionally, they shall be kept current by annual reviews, and updated as appropriate.

Criticality Safety Specifications are prepared by the Plant Criticality Safety Engineer based on limits established in criticality safety analyses provided by the Criticality Safety Component.

The Specifications are accepted and approved in accordance with Figure I-2.2.

Copies of current Criticality Safety Specifications are maintained in the work or storage areas in which the respective specifications apply.

4.1.2 Criticality Safety Standards

Exxon Nuclear has established, and maintains, a system of written Criticality Safety Standards for processes, equipment and facilities involving special nuclear material. These Standards are prepared and maintained by the Criticality Safety Component of Corporate Licensing, and are approved and accepted in accordance with Figure I-2.2. These standards shall be kept current by annual review and updated as appropriate.

4.1.3 Fissile Content Verification

The fissile isotope content of all incoming special nuclear material is verified by gamma energy analysis techniques or laboratory analysis of representative samples prior to the conduct of any activity other than storage.

4.1.4 Special Nuclear Material Control

The movement of fissionable materials is controlled. The criticality safety specifications describes the materials control practices, including the following requirements:

1. Work stations procedurally controlled only on the basis of a safe mass of material are limited to one safe batch, where a safe batch is defined as no more than 0.45 of the minimum critical mass of the material in process.

2. No more than one safe batch may be moved at one time when introducing or removing material from a work station.

3. Individual safe batches are spaced a specified minimum distance apart.

4. A record is maintained of the special nuclear material inventory at each mass limited work station.

These requirements do not apply in systems controlled by geometry, moderation, or fixed neutron absorbers (see Section 4.2).

4.1.5 Labeling of Special Nuclear Material

Insofar as practical, all special nuclear material in the plant is identified with distinctive labels. When possible, the label is applied to the outer container of special nuclear material. When such labeling is not practical, as for fuel pellets outside of containers, each item is identified by identification coding posted in the immediate vicinity of unlabeled items.

1. Content. The label or sign shows, as appropriate, the type of material, form, enrichment, gross, tare and net weights, element or fissile isotope weight, fuel identification number, date, and initials of person preparing the label.

2. Segregation. Materials of different enrichment, physical and/or chemical form, and isotopic content are kept segregated until combination of different materials is required in the process.

4.1.6 Posting of Special Nuclear Material Locations

Each location where special nuclear material is handled, processed, transported or stored is identified by a distinctive symbol which will be observable from all approaches at a distance at least equal to the spacing requirement from other special nuclear material. For work locations separated from other areas by partitions, walls, etc., posting on the opposite side of the obstruction will indicate the spacing limit requirements for special nuclear material in that area.

In addition to the symbol, the location is posted with a sign showing limits specified in the respective Criticality Safety Specification, including type and form of material permitted, allowable quantity (containers, pieces, weight, or volume), restrictions on moderators, required spacing from other special nuclear material, and the applicable Criticality Safety Specification number.

4.1.7 Confirmation of Analysis Assumptions

Prior to the introduction of special nuclear material into a new operation or process a criticality safety analysis will be performed, and a member of the Criticality Safety Component of Corporate Licensing shall inspect the respective facility and/or equipment and confirm that the assumed controls are in place and/or functional. The results of these inspections shall be appropriately documented.

4.2 Technical Practices

Wherever practicable, criticality safety will depend upon equipment designs where dimensions are limited, rather than upon decisions or actions of people. Where this is not practicable, reasons for not using favorable geometry shall be documented as a part of the criticality safety analysis. The following criteria form the bases for criticality safety controls.

4.2.1 Double Contingency Policy

Process and equipment designs and operating procedures incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent errors, accidents, equipment malfunctions, or changes in process conditions before a criticality accident is possible.

4.2.2 Limits on Maximum Multiplication Factors

The maximum evaluated neutron multiplication factor at normal and credible abnormal conditions shall not exceed k_a as defined below.

The maximum allowable multiplication factor will be calculated from the expression:

$$k_a = k_c - \Delta k_u - \Delta k_m$$

where

k_c = The value of k_{eff} that results from the calculation of benchmark experiments using a particular calculational method. The value represents a combination of theoretical techniques and numerical data.

Δk_u = The uncertainty in the benchmark experiments, including random and systematic errors (bias) within the range of parameters encountered in the equipment design.

Δk_m = The value required to ensure an acceptable margin of subcriticality. In the absence of information that justifies a smaller margin of safety, a value of 0.05 will be assumed for Δk_m in equipment design.

4.2.3 Geometry

Wherever practicable, reliance is placed on equipment designs which physically limit the dimensions of units containing special nuclear material.

Safe dimensions may be established by utilizing the following safety factors:

1. The k_{eff} of the unit may be established by using the guidelines given in Section 4.2.2.

2. Critical dimensions multiplied by the applicable safety factors given in Tables I-4.1 and I-4.2.

Where applicable, dimensional limitations include an allowance for fabrication tolerance and/or potential dimensional changes from corrosion or mechanical distortion.

4.2.4 Neutron Absorbers

Criticality safety may be assured through the use of fixed neutron absorbers, such as cadmium, boron, etc., provided that:

1. Neutron absorbers are designed and fabricated as an integral part of the equipment.

2. Inspections to verify the continued integrity of the equipment and neutron absorber structure are performed on established time frequencies sufficient to insure their effectiveness. Results of these inspections, and the basis for the inspection frequencies are recorded and audited.

3. Viable alternatives to the use of fixed neutron absorbers to assure criticality safety do not exist.

4.2.5 Concentration Control

Reliance for primary criticality control may be placed on concentration controls in areas where geometry control is not practicable, and where the nature of the process and operations make violation of the concentration limit

unlikely even after failure of any single control. Concentration control may be applied to both overmoderated and undermoderated accumulations of material as described below.

4.2.5.1 Concentration Control - Solutions

The concentration of fissile material dispersed or dissolved in another medium may be limited to prevent criticality, provided that:

1. The permitted concentration of fissile material in solution shall be equal to or less than fifty percent of the minimum critical concentration in the vessel.

2. The k_{eff} of the system at the maximum allowable concentration shall be limited by using the guidelines given in Section 4.2.2.

3. For individual tanks (non-geometrically safe) using concentration control, the mass shall be limited such that k_{eff} is limited by the guidelines given in Section 4.2.2 for the maximum uranium mass accumulated in the tank under the worst conditions attainable by inadvertent concentration of the fissile material. For large storage systems where concentration of the fissile material is not a credible condition, or where administrative practices are implemented to prevent concentration of the fissile material, the above requirement may be disregarded.

4.2.5.2 Concentration Control - Powders and Pellets

The concentration of hydrogenous material within the fissile material may be limited to a small percentage by weight of the fissile material (moderation control) to prevent criticality, provided that:

1. The permitted concentration of hydrogenous material shall be equal to or less than fifty percent of the critical concentration for the system in question;

2. The maximum reactivity of the system full of the material in question, under the worst credible accident conditions, shall be limited by the guidelines given in Section 4.2.2; and

3. Where practicable, the material shall be contained within a fireproof barrier or in a process area containing limited sources of hydrogenous material. In the absence of a fireproof barrier, special controls shall be used to prevent fires and to control the use of moderators in fire fighting in such process areas.

4.2.6 Multi-Unit Arrays

The spacing between units within an array is limited by mechanical means such that the following requirements are met.

1. The k_{eff} of the array under the maximum credible accident conditions shall be limited by the guidelines given in Section 4.2.2.

2. For multi-unit arrays where k_{eff} is not used as a basis, the number of units in the array shall not exceed 50 percent of the calculated critical number.

The mechanical design of equipment or storage arrays in which deformation or rearrangement could result in the loss of a contingency, shall be reviewed by a person competent in mechanical engineering.

4.2.7 Criticality Safety Parameters

4.2.7.1 Criticality Data

Critical parameters used to establish primary criticality safety limits shall be based on one or more of the following (see Section 4.2.8 for sources of data currently acceptable to Exxon Nuclear):

1. Criticality parameters obtained directly from experimental measurements.

2. Criticality parameters derived from experimental measurements.

3. Theoretical calculations using methods shown to be accurate by validation according to Regulatory Guide 3.14, "Validation of Calculational Methods for Nuclear Criticality Safety."

4.2.7.2 Enrichment Levels

Design isotopic compositions shall be established and appropriate criticality safety controls implemented to assure conformance with the respective fissile element composition prior to initiating respective activities.

Normally, equipment is designed to assure criticality safety by geometry control. Where batch control is utilized, enrichment level or other isotopic composition limits are clearly posted at the respective equipment or location.

4.2.7.3 Moderation

Critical parameters shall be based on optimum moderation unless other than optimum moderation can be assured under both normal and credible abnormal conditions. If used in conjunction with other primary criticality safety parameters, the hydrogen-to-fissile atom ratio shall be maintained such that the resulting k_{eff} of the unit shall be limited by the guidelines given in Section 4.2.2.

4.2.7.4 Reflection

Critical values shall be based on full water reflection unless less-than-full reflection can be assured under both normal and credible abnormal conditions. Consideration shall be given to other reflectors in the immediate vicinity which could result in a reactivity greater than that for a water-reflected system.

4.2.7.5 Neutron Interaction

Neutron interaction (exchange between individually subcritical units) shall be considered. Consideration of the interaction between units or arrays of special nuclear material may be accomplished through the use of the Solid Angle method.

The Solid Angle method is applied according to the constraints in the "Nuclear Safety Guide," TID-7016, Rev. 2, except for the use of the nominally reflected solid angle acceptance criteria. The nominally reflected solid angle acceptance criteria are used to limit the allowable solid angle for arrangements of individually subcritical units provided that:

1. Boundary conditions for the spacing between concrete walls and the array are as stated in Table I of Reference (21), except that a minimum separation of six inches shall be required;

2. Concrete walls are less than or equal to seven inches in thickness;

3. Separation distances given in Table I of Reference (21) are measured from the outermost vessel in the array to the closest wall;

4. The array shall be limited in both number and size of vessels to arrays that are reasonable extrapolations of the conditions assumed in Reference (21); and

5. All vessels within the array shall be subcritical when fully reflected by water and shall have a minimum edge-to-edge separation of 12 inches.

For arrays that violate any of the five conditions stated above, additional analyses will be necessary to: (1) demonstrate the safety of the particular array in question; or (2) demonstrate the continued acceptability of using the nominally reflected solid angle acceptance criteria.

The above methods will have been validated according to Regulatory Guide 3.14, "Validation of Calculational Methods for Nuclear Criticality Safety".

4.2.8 Sources of Criticality Data and Analytical Techniques

The sources of criticality data and analytical techniques currently used by Exxon Nuclear in performing criticality safety analyses are identified below:

1. J. H. Chalmers, G. Walker, and J. Pugh, "Handbook of Criticality Data," UKAEA Handbook AHSB (S), 1965.

2. H. C. Paxton, J. T. Thomas, D. Callihan, and E. B. Johnson, "Critical Dimensions of Systems Containing ^{235}U, ^{239}Pu, and ^{233}U," TID-7028, Division of Technical Information Extension, USAEC (1964).

3. Subcommittee 8 of the American Standards Association Sectional Committee N6 and Project 8 of the American Nuclear Society Standards Committee, "Nuclear Safety Guide," TID-7016, Rev. 2, Division of Technical Information Extension, USAEC (1978).

4. H. K. Clark, "Critical and Safe Masses and Dimensions of Lattices of U and UO_2 Rods in Water," DP-1014, Savannah River Laboratory (1966).

5. H. K. Clark, "Maximum Safe Limits for Slightly Enriched Uranium and Uranium Oxide," Criticality Control of Fissile Materials, International Atomic Energy Agency, Vienna (1966), pp. 35-49.

6. H. C. Paxton, "Criticality Control in Operations with Fissile Material," LA-3366, Los Alamos Scientific Laboratory (1972).

7. H. F. Henry, C. E. Newlon, and J. R. Knight, "Extensions of Neutron Interaction Criteria," K-1478, Union Carbide Corporation, Nuclear Division (1969).

8. C E. Newlon, AEC Research and Development Report, "Minimum Critical Cylinder Diameters of Hydrogen Moderated U (4.9) Systems," K-1629, Union Carbide Corporation, ORGDP, March 15, 1965.

9. Standards Committee N16 of the American National Standards Institute, "Nuclear Criticality Safety in Operations with Fissionable Matearials Outside Reactors," ANSI N16.1-1969, American National Standards Institute, New York, NY (1969).

10. R. D. Carter, G. R. Kiel, and K. R. Ridgway, "Criticality Handbook," Volumes I, II and III, ARH-600, Atlantic Richfield Hanford Company, June 1968.

11. W. Thomas, W. Weber, and W. Heinicke, "Handbuch zur Kritikalitat," 1970-73.

12. L. L. Carter, C. R. Richey, C. E. Hughey, "GAMTEC-II: A Code for Generating Consistent Multigroup Constants Utilized in Diffusion and Transport Theory Calculations," BNWL-35, March 1965.

13. H. Honeck, "THERMOS Code," BNL-5826, 1961.

14. J. R. Lilley, "Computer Code HFN - Multigroup, Multiregion Neutron Diffusion Theory in One Space Dimension," HW-71545, November 17, 1961.

15. B. G. Carlson and W. Guber, "DTF Users Manual," UNC Phy/Math-3321, Vol. I, November 1963.

16. J. E. Suich and H. C. Honeck, "The Hammer System," DP-1064, Savannah River Laboratory (1967).

17. P. J. Hemmings, "The Gem Code," AHSB (S) R 105, United Kingdom Atomic Energy Authority (1967).

18. H. F. Henry, "Studies in Nuclear Safety," K-1380, June 1957.

19. BNW/JN-29, "Nuclear Criticality Safety Analysis, Uranium Fuels Plant," Jersey Nuclear Company, C. L. Brown, Battelle Northwest Laboratory, March 1971.

20. JN-71-2, "Determination of H/U Ratios in UO_2 Water and ADU-Water Mixtures," May 5, 1971.

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21. BNW/XN-184, C. L. Brown, et. al., "Validation of Boundary Conditions for Assuming Nominal Reflection in Solid Angle Interaction Method (As Applied in Exxon Fuel Fabrication Plants)," Battelle Pacific Northwest Laboratories, March 1975.

22. "SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation," NUREG/CR-0200.

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Table I-4.1 Safety Factors for Homogeneous Single Units

Safety Parameter	Critical Parameter	Safety Factor
Safe Mass, M_s	Critical Mass, M_k	0.45
Safe Mass, M_{sL} (Doubling of M_{sL} is excluded by construction)	Critical Mass, M_k	0.75
Safe Spherical Volume, V_s	Critical Spherical Volume, $V_k \leq 5\ell$	0.75
	$V_k > 5\ell$	0.80
Safe Infinite Cylinder, D_s	Critical Infinite Cylinder, D_k	0.85
Safe Infinite Slab, S_s	Critical Infinite Slab, S_k	
	$S_k < 3$ cm	0.75
	$S_k > 3$ cm	0.85
Safe Concentration, C_s	Critical Concentration, C_k	0.50

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Table I-4.2 Safety Factors for Heterogeneous Single Units

Safety Parameter	Critical Parameter	Safety Factor
Safe Mass, M_s	Critical Mass, M_k	0.45
Safe Mass, M_{sL} (Doubling of M_{sL} is excluded by construction)	Critical Mass, M_k	0.70
Safe Spherical Volume, V_s	Critical Spherical Volume, V_k	0.75
Safe Infinite Cylinder, D_s	Critical Infinite Cylinder, D_k	0.85
Safe Infinite Slab, S_s	Critical Infinite Slab, S_k	0.85

CHAPTER 5

ENVIRONMENTAL PROTECTION

CHAPTER 5 ENVIRONMENTAL PROTECTION

5.1 Effluent Controls

5.1.1 Gaseous Effluent Controls

Exxon Nuclear shall maintain and use gaseous effluent treatment systems to maintain releases of radioactive material in gaseous effluents to unrestricted areas as far below the limits specified in 10 CFR 20.106 as is reasonably achievable. Procedures are established by Table I-5.1 which are adequate to assure that the effluent treatment systems are functioning properly and that immediate steps are taken to rectify any observed deficiencies as soon as practicable.

Continuous isokinetic sampling is provided on all exhaust air stacks servicing areas in which uncontained radioactive materials are used, processed, or otherwise handled. These samples are analyzed for radioactive material content on a weekly basis. Samples of gaseous effluents potentially containing uranium are analyzed for gross alpha activity.

In the event that the radioactivity in gaseous effluents exceeds 50 μCi per calendar quarter, a report shall be submitted to the NRC within 30 days, identifying the cause and corrective actions to be taken by the Company to reduce release rates (Table I-5.2).

If parameters important to dose assessment of the public change relative to gaseous effluents from the plant, a report shall be submitted to the NRC within 30 days, identifying the changes in the parameters, and providing an estimate of the resultant change in dose commitment.

In the event that the calculated dose to any member of the public in any consecutive 12-month period is about to exceed the limits specified in 40 CFR 190.10, the Company shall take immediate steps to reduce emissions so as to comply with 40 CFR 190.10.

5.1.1.1 HEPA Filtration

Air from contaminated areas and process equipment or enclosures where uncontained uranium compounds are handled shall be passed through one stage of fire-retardant HEPA filters which meet Standard MIL-F-51068 prior to being exhausted to the atmosphere. Filtration is not required for air exhausted from rooms or facilities where radioactive materials are encapsulated or otherwise contained and the outside surfaces of the container have been surveyed and released.

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Only HEPA filters which are certified by the manufacturer to be at least 99.97 percent efficient for the removal of 0.3 micron particles shall be used. The adequacy of final HEPA filter installations shall be determined by in-place testing to assure that they are at least 99.95 percent efficient for the removal of 0.8 micron particles prior to initiating operations with radioactive materials in the following instances:

a. Startup of a new facility;

b. Following maintenance work on the filter bank and/or replacement filters; or

c. Following actuation of the sprinkler deluge system.

5.1.1.2 Final HEPA Filter Protection

Air exhausted from process equipment containing corrosive fumes is liquid scrubbed and heated prior to final HEPA filtration. Final HEPA filters potentially exposed to corrosive fumes are visually inspected at least quarterly.

Final HEPA filters in the fuel fabrication buildings are protected from damage in the event of fire by one of the following design features:

1. A liquid scrubber in the exhaust air stream upstream of the filters.

2. An automatic (actuated by heat detectors located in the exhaust air ducts) sprinkler deluge system in the exhaust air stream upstream of the filters.

3. An automatic (actuated by heat detectors located in the exhaust air ducts) cool air injection system in the exhaust air stream upstream of the filters.

Final HEPA filter installations are equipped with continuous pressure differential measuring/indicating devices, which are read and the readings recorded at least monthly. The Δp across final HEPA filters is not allowed to exceed four inches of water gage.

5.1.2 Liquid Effluent Controls

Exxon Nuclear shall maintain and use liquid effluent treatment systems to maintain releases of radioactive material in liquid effluents to unrestricted areas as far below the limits specified in 10 CFR 20.106 as is reasonably achievable, and in accordance with 10 CFR 20.303. Procedures have been

established which are adequate to assure that the effluent treatment systems function properly and that immediate steps are taken to rectify any observed deficiencies as soon as practicable.

Released liquid wastes are combined and discharged to the EN-City Lift Station where the total combined liquid effluent from the plant is pumped to the Richland Municipal Sewerage System. The combined liquid effluent is continuously sampled and the flow is measured prior to the lift station. The composited samples are analyzed for uranium and regulated chemicals. Any increase in the chemical or uranium content of the composited samples statistically above those limits described in 10 CFR 20.303 or the State of Washington Liquid Waste Discharge Permit shall be cause for an immediate investigation of the problem and appropriate corrective action.

5.1.2.1 Sanitary Wastes

Sanitary wastes are discharged to the sanitary sewer system which joins other liquid wastes prior to being discharged to the EN-City Lift Station.

5.1.2.2 Process Cooling Waste Water

Process cooling waters are isolated from the actual process atmospheres by double physical barriers.

Process cooling water is discharged from various facilities (with the exception of the ELO Building) via building sewer systems separate from both sanitary and process chemical waste sewers. The process cooling waste waters may be disposed of by any one of the following methods:

1. Discharged to the municipal sewerage system;
2. Discharged to a seepage pond;
3. Used to irrigate Exxon Nuclear property; or
4. Discharged to the Exxon Nuclear Process Chemical Waste Storage Lagoon System.

5.1.2.3 Process Chemical Wastes

All process radioactive liquid wastes are routed to lagoon storage. Some lagoon solutions require further treatment prior to discard to the sewer. These solutions may be treated as necessary for chemical/radioactivity removal prior to release to the sanitary sewer system.

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5.1.3 Process Chemical Waste Storage Lagoon System

The lagoons are sealed on the bottom and all sides with an impervious liner to prevent leakage of the lagoon contents to the groundwater. The liner consists of a double layer of impervious material separated by a layer of sand. A system of sampling tubes is installed in the intermediate sand layer to provide sampling capability between the liner layers to permit detection of leaks in the first barrier.

Routine monitoring of the integrity of the upper liners will be accomplished by drawing a vacuum on each group of the "between-liners" sampling heads at least monthly. In the event that a significant amount of liquid is pumped from any sampling head(s), the liquid will be analyzed for fluoride and uranium content. If uranium and fluoride are present, an investigation will be initiated which will include:

1. Additional between-liner sampling;

2. Lagoon solution sampling;

3. Checking the integrity of the bottom Hypalon liner of affected lagoons; for lagoons numbers 1 and 3 by activating sampling lines located between the bottom Hypalon liners and the original Petromat liners of these two lagoons; or

4. Checking the integrity of the bottom Hypalon liner of lagoon number 4 by sampling the three dry wells associated with the three "French Drains" located under the bottom liner of this lagoon; and

5. Making maximum use of the lagoon test well system.

The between-liner sampling system is the first line of defense for detecting liner leaks and sampling is scheduled monthly. The beneath the bottom liner leak detection system is activated at any time the first liner is determined to be leaking to confirm the integrity of the bottom liner. Test wells are provided around the Lagoon System as a backup to provide the capability to detect leaks penetrating both liner layers and to follow the movement of any groundwater contamination. In addition, these test wells are sampled periodically as a part of our environmental monitoring program to maintain a general overview of concentrations in the groundwater of those chemicals which are representative of lagoon solutions as well as uranium.

In the event that a leak in an upper liner is detected, repair of the liner will be scheduled and completed. A report of the leak including results of the investigation and corrective actions taken will be forwarded in writing to the Director, Region V within 90 days of detection of the leak.

5.2 Environmental Monitoring

Exxon Nuclear conducts a routine environmental surveillance program in relation to the operation of the Richland Plant. Surface and groundwater samples are collected from strategic locations in the environment and analyzed for pertinent chemicals and uranium.

5.2.1 Surface Sampling

Sampling stations have been established both on-site and off-site near points of expected maximum concentrations. The schedule for the various sampling stations are identified in the following table. See Figure I-5.1 for the location.

Sample Station	Sample Type	Sampling Frequency	Analysis
1	Soil	Quarterly	Uranium
2	Soil	Quarterly	Uranium
3	Air	Monthly	Fluoride
4	Air	Monthly	Fluoride
5	Forage	Monthly[1]	Fluoride
6	Forage	Monthly	Fluoride

5.2.2 Groundwater Sampling

Potential releases to the groundwater from the liquid waste storage lagoons are monitored by sampling the "between liners" leak detection system. If liquid is found an investigation is initiated. Test wells around the periphery of the lagoon system are monitored to indicate whether leaks have penetrated both upper and lower lagoon liners and have released any of the stored liquid chemical waste to the groundwater. These test wells also monitor the concentrations and movement of chemicals in the groundwater. The groundwater sampling program is provided by the following table. See Figure I-5.2 for the locations of the sample stations.

1 During the growing season only (April-October).

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Presence of liquid	Monthly	Lagoon interliner sampling system	Grab
Gross Alpha/Beta[1]	Quarterly	Well Group 1	Grab
Gross Alpha/Beta[1]	Semi-annually	Well Group 2	Grab

Monitoring Well Group 1 is Wells 1-7, 11, 12, 13 and 19-21.

Monitoring Well Group 2 is Well 9, 14, 15, 16.

1 The analytical method shall be capable of detecting 5 pCi/L alpha and 15 pCi/L beta.

I. Concentrations (Individual Stacks) Action Levels Seven-Day Sample Results (μCi/ml-Alpha)	Selection Criteria	Required Actions(1)
5×10^{-13}	Represents Exxon Nuclear's design objective.	Recount sample(s); check operations for possible source, if activity is confirmed. Increase sampling frequency to daily; check pressure drop across all exhaust HEPA filters; reevaluate all relative exhaust sampler results; check for proper seating of related HEPA filters. Update summation of quantity of radioactive material released via gaseous effluents on a weekly basis until a discharge concentration below this Action Level is sustained for a full calendar quarter.
5×10^{-12}	Represents Exxon Nuclear's annual Control Value (at stack).	Shutdown associated intake fans and reduce exhaust flow rate; prepare to shutdown associated process; inspect all related HEPA filters and replace all that exhibit any indication of inadequacy; if final HEPA filters exhibit any deficiencies, replace them and DOS (in-place) test the final filter bank.

I. Concentrations (Individual Stacks)
Action Levels
Seven-Day Sample Results (μCi/ml-Alpha)

	Selection Criteria	Required Actions(1)
5×10^{-10}	Preliminary corrective action not adequate. This value (at stack) would yield approximately the 10 CFR 20 Limiting Values (annual) at the nearest unrestricted area.	Initiate orderly shutdown of associated process for repair or correction of substandard conditions. Initiate environmental air sampling in downwind sector(s).
2.5×10^{-7}	This value (at stack) would yield approximately 500X the 10 CFR 20 Limiting Values at the nearest unrestricted area. If this value is sustained for 24 hours, notification within 24-hours is required.	Shutdown associated processes and HVAC systems immediately; notify NRC Region V I&E Office within 24 hours if this concentration is sustained for a 24-hour period.
2.5×10^{-6}	This value would yield approx. 5000X the 10 CFR 20 Limiting Values at the nearest unrestricted area. If sustained for 24 hours, immediate notification is required.	Shutdown associated process and HVAC systems immediately; notify NRC Region V I&E Office immediately if this concentration is sustained for a 24-hour period.

II. Quantities (Total Gaseous Effluent)

Action Levels (μCi)	Selection Criteria	Required Actions(1)
25 Per Calendar Quarter	1/2 of license condition Report Value.	Evaluate all gaseous effluent sampling data for the previous quarter to identify potential problems; investigate identifed sources of elevated concentrations of radioactive material in gaseous effluents as described in (for Action Levels less than ENC Annual Control Values) Table I-5.1.
40 Per Calendar Quarter	Approaching license condition Report Value.	Take actions specified for Action Levels representing ENC Annual Control Values in Table I-5.1. Update summation of quantity of radioactive material released via gaseous effluents on a weekly basis until a weekly discharge rate of less than or equal to one micro-curie has been sustained for a full calendar quarter.
>50 Per Calendar Quarter	License condition Report Value.	Submit report to NRC within 30 days identifying cause, along with corrective actions taken to reduce release rates; prepare to petition the NRC for a variance in accordance with the conditions of 40 CFR 190.11.

(1) Actions required at any one Action Level includes all action that would have been undertaken at lower Action Levels.

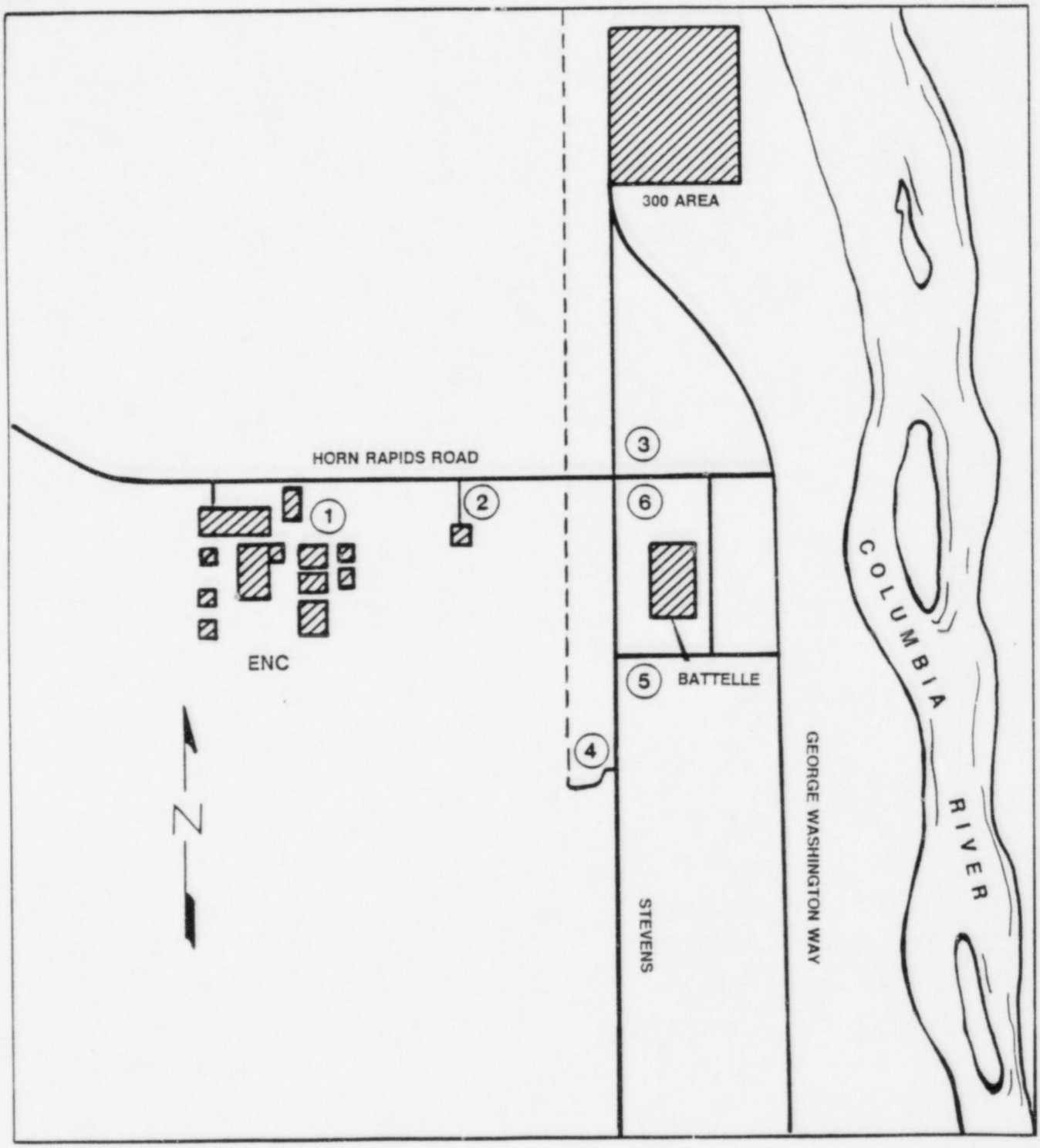
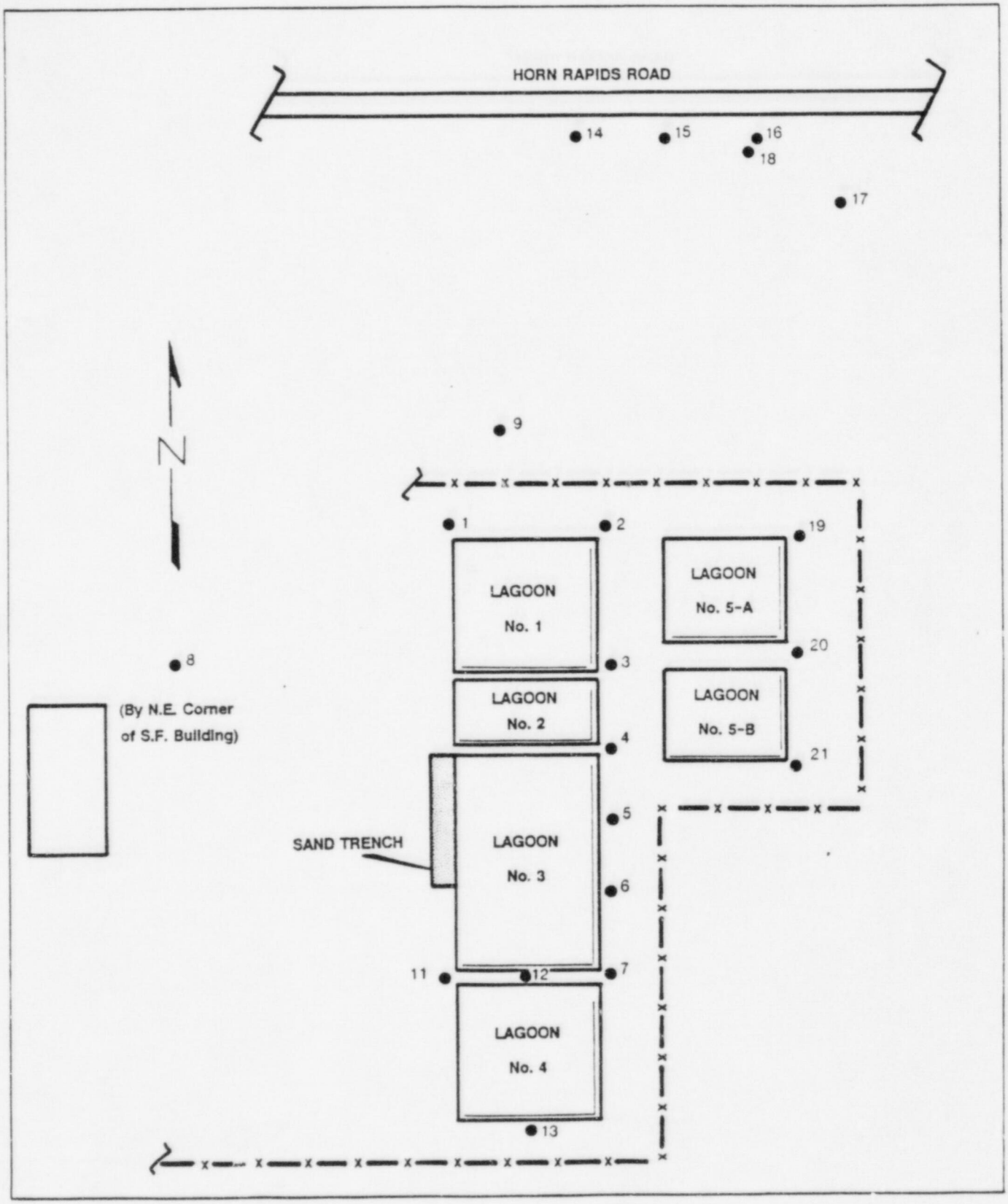


FIGURE 1-5.1

FIELD SAMPLE STATION LOCATIONS



LAGOON TEST WELL LOCATIONS

FIGURE 1-5.2

CHAPTER 6

SPECIAL PROGRAMS

CHAPTER 6 SPECIAL PROGRAMS

6.1 Proprietary Information

With application for license amendment dated June 12, 1985 for operation of a dry conversion process Exxon Nuclear submitted copies of document XN-NF-837, Part II, "License Amendment Application, Dry Conversion Process, Proprietary Supplement," dated June 1985 and requested that it be withheld from public disclosure pursuant to 10 CFR 2.790. An accompanying affidavit dated June 13, 1985 was also submitted. The U.S. Nuclear Regulatory Commission did determine that the submitted document did contain trade secrets or confidential or proprietary commercial information (letter, R. E. Cunningham to C. W. Malody, dated July 19, 1985). Amendment No. 26, dated November 7, 1986 was subsequently issued permitting operation and no additional conditions of license were imposed.

6.2 Occupational Safety

Exxon Nuclear follows the current American Conference of Governmental Industrial Hygienists (ACGIH), Washington Industrial Safety and Health Administration (WISHA) and Nuclear Regulatory Commission (NRC) maximum permissible concentrations, threshold value limits, and permissible exposure limits for radioactive and hazardous chemicals in the design and operation of its fuel fabrication facility.

In case of a known release, Plant Operations personnel will contact Safety and Security Operations personnel to ascertain the concentration levels and the recommended personnel protective equipment required for cleanup operations to proceed. Safety and Security Operations personnel conduct routine or periodic surveys as appropriate to determine the concentrations of routinely utilized radioactive and hazardous chemicals.

6.3 Emergency Utilities

6.3.1 Emergency Electrical Power Supply

Turbine generator sets are installed to provide emergency electrical power to operate the Criticality Accident Alarm System, selected exhaust fans, telephones, radiation detection instrumentation, critical process equipment, and also provide emergency lighting.

These generators are tested at least monthly for proper startup and operation. Functional tests consisting of tying the generator to a normal emergency load are performed at least annually.

6.3.2 Emergency Backup Water Supply

The water supply to the Exxon Nuclear manufacturing facilities is furnished by the City of Richland through separate 10-inch and 12-inch mainlines connected into a loop feeding the plant fire loop. The City of Richland estimates the flow at the fire loop to be 1600 gpm at 40 psi through each line, resulting in 3200 gpm at 40 psi from the two lines. A more conservative estimate of reliable, available flow of 2500 gpm at 40 psi provides ample supply for hose lines and exhaust ventilation filter deluge protection. Normal UO_2 Building water needs are about 200 gpm.

The source of water for Richland is the Columbia River. Primary backup is furnished by a 15 million gallon equalizing reservoir on a bluff south of the City at an elevation of 545 feet. Wells, which were the earlier source of water for the City before the construction of the present water filtration plant on the river, have been kept in condition as a secondary backup source.

6.4 Radioactive Waste Management

6.4.1 Liquid Wastes

Radioactive and chemical wastes from the process and laboratories are routed to the Process Chemical Waste Storage Lagoon System. Based on the chemical and radioactive (uranium) content the lagoon waste may be processed through the Lagoon Uranium Recovery (LUR) Facility and/or the Ammonia Recovery Facility prior to being sampled and released to the sewer system.

6.4.2 Solid Radioactive Waste

Uranium-contaminated solid waste is segregated into noncombustible and combustible types and is stored either in a warehouse or other designated area within the controlled access area. Containers used for this purpose are adequately sealed and appropriately labeled prior to being stored. In the event that such containers of waste are stored outdoors for extended periods of time, their physical integrity shall be visually inspected and the accumulation shall be surveyed for external radioactive material contamination at least quarterly, and records of such inspections and surveys shall be maintained.

Combustible waste may be processed through the Solid Waste Uranium Recovery (SWUR) facility to obtain volume reduction and the recovery of uranium.

Noncombustible waste is stored until shipment to a permanent waste storage site.

CHAPTER 7

DECOMMISSIONING PLAN

CHAPTER 7 DECOMMISSIONING PLAN

7.1 Decommissioning Criteria

The decommissioning plan has been prepared to meet the guidelines and requirements as specified in Annex C which is appended to Chapter 3:

> "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product Source or Special Nuclear Material," U.S. Nuclear Regulatory Commission, November 1976.

7.1.1 Uncontaminated Facilities

The disposition of uncontaminated equipment and facilities is not within the scope of this plan, provided that such facilities are verified to be uncontaminated in accordance with approved radiation survey procedures.

7.1.2 Residual Radiation Levels

The residual contamination levels in decontaminated facilities to be unconditionally released shall be within the values given in Table I of Annex C. Any equipment or facility which cannot be decontaminated to those levels shall be transferred to another licensed facility or demolished, packaged and disposed of at a licensed low-level radioactive waste disposal site.

7.1.3 Records

Records of the decommissioning procedures and results will be preserved for at least five years or as required by then current regulations.

7.1.4 Future Changes

The decommissioning plan assumes the availability of a low-level radioactive waste disposal facility at reasonable cost, and packaging and transportation requirements consistent with existing regulations.

7.1.5 Financial Provisions

Decommissioning of the Exxon Nuclear facility will be conducted at no cost to the public beyond those of ordinary regulatory activities.

7.2 General Assumptions

The following general assumptions were used in the preparation of the Decommissioning Plan and cost estimate for the decommissioning of licensed facilities at the Horn Rapids Plant of Exxon Nuclear Company, Inc.

1. Prior to the start of decontamination, a detailed decommissioning plan, including a proposed closeout survey plan, will be submitted to the NRC for review and approval. The closeout survey shall be reviewed and approved by NRC prior to release of equipment or grounds to unrestricted use.

2. All work will be performed in full compliance with an approved QA program written and established specifically for the decommissioning activity.

3. All work inside contaminated areas will be performed using approved health physics procedures.

4. Exxon Nuclear health physic technicians will be available during the entire decommissioning activity.

5. The decommissioning cost of all noncontaminated areas and equipment would either be offset by their salvageable value or are not of interest to the NRC, and are not addressed in this plan and estimate.

6. As a basis for estimating, all decommissioning of the buildings and process equipment would be accomplished within six months and decommissioning of the waste lagoons would be accomplished within one year.

7. The costs associated with decontamination of process equipment and ventilation duct work will be greater than the salvage value and, therefore, no attempt at decontamination will be made. All contaminated process equipment and duct work will be disposed of by burial in low-level waste disposal sites, and only the facility will be decontaminated.

7.3 Procedures

The following general procedures will be followed in decontaminating each major facility. Minor ancillary facilities such as external docks and grounds where contamination may be found will be decontaminated in a similar fashion. In preparation for decommissioning, detailed procedures will be prepared in accordance with an approved QA program.

7.3.1 UO_2 Building

1. All process equipment in the various controlled areas of the building will be surveyed to determine the degree of contamination. Equipment which is below the release levels of contamination will be disconnected and disposed of on a commercial basis. Equipment which is contaminated to levels above the release levels will be disconnected from the building services, decontaminated if warranted, and/or wrapped in polyethylene and packaged for shipment. The contaminated equipment will be either transferred to another licensed facility or a licensed radioactive waste disposal site.

   Liquid effluent systems leading from the controlled zones will be treated in the same manner as process equipment in the controlled zones.

   Sufficient radiation surveys of process equipment outside the controlled zones will be made to assure that no contamination has spread outside the zones. Process equipment outside the controlled zones will be disposed of on a pure commercial basis.

2. All exhaust duct work will be treated in a manner similar to the process equipment as described in item 1 above. The final filter bank of the ventilation system will also be disposed of by burial.

3. After removal of all process equipment and exhaust ducting, the facility ceiling and walls will be steam cleaned as necessary.

4. The floors of the controlled areas will be sandblasted in order to strip all paint and cleaned using steam and/or solvents.

5. A radiation survey will be completed to a prescribed plan to verify that areas are successfully decontaminated.

6. After NRC approval, the entire effected area will be resurfaced as appropriate.

7.3.2 Specialty Fuels (SF) Building

1. In the Fall of 1985, Exxon Nuclear successfully decontaminated and decommissioned the PuO_2 equipment and facility in Room 173 of the SF Building. NRC released the area from plutonium control and the SWUR facility was installed in the vacated room. The only plutonium remaining in the building is plutonium waste stored in 35 containers in the storage vault. At the time of decommis-

sioning of the SF Building, or sooner, these containers will be either transferred to another licensed facility or a licensed radioactive disposal site for burial.

2. Decontamination and decommissioning of the SF Building will be accomplished in a similar manner as the UO_2 Building, as described in Section 7.3.1.

7.3.3 Ancillary Facilities

In addition to the UO_2 and SF Buildings, the facilities listed below are all involved with enriched uranium handling and processing in varying degrees, and will therefore be required to be decontaminated:

1. Engineering Laboratory (ELO) Building
2. Contaminated Clothing Laundry
3. Fuels Storage Warehouse
4. Radioactive Material Warehouse
5. Fuel Cooling Test Facility (FCTF)
6. UF_6 Receiving and Storage Facility
7. Lagoon Uranium Recovery (LUR) Facility
8. Ammonia Recovery Facility

The same basic plan as outlined in Section 7.3.1 above will be used in the decontamination and decommissioning of these ancillary facilities.

7.3.4 Waste Water Lagoons

1. The feed lines to the lagoons, as well as all interconnecting lagoon piping, will be removed, wrapped in polyethylene, packaged, and turned over to a licensed radioactive disposal company for burial.

2. The lagoons will be emptied on a programmed basis.

3. After the liquid has evaporated or been disposed of, all residual solids will be packaged and transported to a radioactive burial site.

4. The lagoon liners will then be cut into manageable sections, rolled, wrapped in polyethylene, packaged, and turned over to a licensed radioactive disposal company for burial.

5. The soil beneath the lagoons will be surveyed and any contamination above release limits will be excavated and appropriately disposed of.

PART I - LICENSE CONDITIONS | REV.

7.4 Cost Estimate

The estimated cost of decommissioning is $7,500,000 in 1986 dollars, distributed in categories as follows:

UO_2 Building	$ 981,000
SF Building	383,500
Ancillary Facilities	324,000
Lagoons	524,000
Burial Costs	3,750,000
Administration	300,000
Radiation Surveys	100,000
Safety Equipment	100,000
QA/QC Administration	100,000
Contingency	937,500
TOTAL ESTIMATED COST	$7,500,000

Total estimate includes the following typical quantities and unit costs:

1. 30,000 labor manhours at $30/hr.
2. 150,000 cubic feet of burial boxes constructed at material cost of $5/cubic foot.
3. Sandblasting of 19,100 square feet of floor area.
4. Painting of 87,600 square feet of walls, floors and ceilings.
5. 150,000 cubic feet of burial material at $25/cubic foot.
6. 2,000 cubic yards of excavation for the lagoons.

7.5 Financial Assurance

Exxon Nuclear is a wholly-owned subsidiary of the Exxon Corporation. A copy of the latest corporate annual report is appended to Chapter 9 of this application. The report is an indication of the availability of the necessary funds to cover the estimated costs of plant decommissioning.

PART I - LICENSE CONDITIONS	REV.
A letter from a Vice President of Exxon Corporation, which gives specific assurance of the availability of the required funds, is appended to this chapter. (See Appendix A.)	

PART I - LICENSE CONDITIONS | REV.

APPENDIX A

CHAPTER 7

EXXON CORPORATION

1251 AVENUE OF THE AMERICAS, NEW YORK, N.Y. 10020 -1198

September 9, 1986

Mr. W. T. Crow, Chief
Uranium Fuel Licensing Branch
Division of Fuel Cycle and
Material Safety, NMSS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: License No. SNM-1227
Docket No. 70-1257

Dear Mr. Crow:

Exxon Corporation hereby assures that Exxon Nuclear Company, Inc., its 100% owned affiliate, at the time of decommissioning will have available to it the resources required to satisfy its obligation to decontaminate and decommission the Richland Fuel Fabrication Facility.

Very truly yours,

L. K. Strohl
Vice President

CHAPTER 8

RADIOLOGICAL CONTINGENCY PLAN

CHAPTER 8 RADIOLOGICAL CONTINGENCY PLAN

Exxon Nuclear has developed and published a Radiological Contingency Plan as document XN-NF-32A entitled, Exxon Nuclear Company Richland Fuels Fabrication Plant Emergency and Radiological Contingency Plan. This plan was first submitted to the Nuclear Regulatory Commission on August 20, 1981 and was incorporated into this license as Amendment No. 2 on March 29, 1982.

The licensee shall maintain implementing procedures for the plan. In addition, the licensee shall make no change in the plan, without the approval of the Commission, if the change would decrease the effectiveness of the plan. The licensee may make changes to the plan provided the changes do not decrease the effectiveness of the plan. The licensee shall maintain a record of each change for a period of two years. In addition, the licensee shall provide a description of each change to the Chief, Uranium Fuels Licensing Branch and Administrator NRC Region V within six months after each change is made.

PART II

SAFETY DEMONSTRATION

CHAPTER 9

GENERAL INFORMATION

CHAPTER 9 GENERAL INFORMATION

9.1 Corporate Information

The names, state of residence and citizenship of the current principal officers of Exxon Nuclear Company, Inc. are listed in Table II-9.1. Exxon Nuclear Company, Inc. is neither owned, controlled nor dominated by an alien, foreign corporation or foreign government.

The top organizational structure of Exxon Nuclear Company, Inc. is depicted in Figure II-9.1. The President reports to the Board of Directors and directs all company functions. The fuel fabrication plant, to which this license applies, is under the sole direction of the Vice President, Engineering and Production Division.

There are four Departments within the Engineering and Production Division which are involved in the handling and/or processing of special nuclear material. These are: Operations-Richland, Materials and Scheduling, Process and Equipment Engineering, and Fuel Engineering and Technical Services. Additional descriptive information on these organizations was presented in Chapter 2.

9.2 Financial Qualification

A copy of the annual report for 1985 of Exxon Corporation is appended at the end of this chapter which describes the financial condition of the parent corporation of Exxon Nuclear.

9.3 Summary of Operating Objective and Process

9.3.1 General

The objective of activities covered by this license application is the production of low enriched uranium fuel for light water reactors. This is accomplished by beginning with UF_6 as a feed stock and incorporates processes ancillary to the main process including liquid waste treatment and disposal, scrap recovery and recycle, and combustible waste incineration and disposal. Plant capacity is nominally 700 metric tons per year. A very brief description of the main line process is given below.

9.3.2 Summary Process Description

Enriched (less than or equal to 5% U-235) uranium hexafluoride (UF_6) is transported to the Richland fuel fabrication plant by truck in Model 30 cylinders. The UF_6 to UO_2 conversion process employed is either the "Ammonium Diuranate (ADU) Process" or the "Dry" conversion process. In the

first UF_6 is vaporized, hydrolyzed, and then precipitated with ammonia as ADU; the ADU solids are separated from liquid wastes, then passed through a reduction furnace, resulting in UO_2 powder. The Dry Conversion process is considered proprietary and is not further discussed. The UO_2 powder is passed directly to a blending-milling-slugging-granulating operation in a closed system and then to pellet pressing or to interim storage.

The powder is fed directly to the press hoppers to the rotary presses through flexible, dust-tight hoses. The press platen areas are hooded and vented to prevent UO_2 dust release to the room. "Green" (unsintered) fuel pellets are conveyed from the presses and loaded into sintering containers.

The fuel pellets are sintered in a controlled hydrogen atmosphere in electrically-heated furnaces. The containers of sintered fuel pellets are removed from the furnaces and released for grinding. The UO_2 ground off the fuel pellet surface is washed away by flowing water. UO_2 solids are centrifuged from the rinse waters and are processed to recover the uranium.

The sintered, ground fuel pellets are heated in furnaces to remove moisture, and then moved to the fuel rod loading station. After one end cap has been welded onto the cladding tube, the open end is inserted into a glove box and pellets are pushed horizontally along a V-trough into the cladding tubes. Final closure welding of fuel rods is done in controlled atmosphere welding chambers.

The sealed fuel rods are leak tested and then are moved to a fuel rod enrichment assay device. After fuel rod enrichment assay, the fuel rods are radiographed for weld quality, cleaned, visually inspected for surface defects, and then stored in trays until released for fuel element assembly.

Fuel rods are withdrawn from storage as needed and fabricated into fuel assemblies. The assembly is thoroughly inspected for dimensional characteristics and workmanship. After inspection, fuel assemblies maybe stored within the nuclear fuel fabrication building or packaged in shipping containers for shipment to nuclear power stations. Fuel assemblies may also be packaged and stored in their shipping containers in advance of shipment.

9.3.3 Uranium Scrap Reprocessing

Discrepant sintered UO_2 is recycled into the process by oxidizing to U_3O_8 and then blending into UO_2 powder or the U_3O_8 powder is dissolved in nitric acid to form uranyl nitrate which is pumped into either conversion line and precipitated using the ADU process.

Mixed impure scrap (floor sweepings, grinder sludge, laboratory samples, impure pellets, etc.) is accumulated in a designated storage area and reprocessed on a campaign basis. The process for uranium scrap reprocessing is the classical nitric acid dissolution, solvent extraction-stripping, ammonium diuranate precipitation, calcination technique.

9.3.4 Process Changes Since Last License Renewal

9.3.4.1 Lagoon Uranium Recovery

Uranium can now be recovered from chemical process waste solutions. The stored waste liquid is pumped from on-site lagoons into large process vessels where uranium is chemically precipitated from the solution. The uranium-bearing slurry is then drummed and stored for purification. Purification occurs in the scrap reprocessing facility.

9.3.4.2 New U_3O_8 Facility

A new contaminated maintenance shop and U_3O_8 scrap recovery facility were built connected to the UO_2 Building. The new facility converts scrap UO_2 to U_3O_8 which is then screened and loaded into drums for storage.

9.3.4.3 Ammonia Recovery Facility

A chemical process waste treatment facility was built to strip ammonia from the chemical process liquid wastes. The recovered ammonia is recycled back into the UF_6-UO_2 conversion processes and the remaining waste solution is discarded to sewer.

9.3.4.4 Dry Conversion

A dry conversion UF_6-UO_2 process was developed as an option to the ADU process and produces UO_2 powder at greatly reduced liquid waste rates. The process and equipment are considered proprietary.

9.3.4.5 Incineration of Uranium-Contaminated Combustibles

An incinerator was installed in the Specialty Fuels Building for incineration of uranium-contaminated combustible waste. Uranium is recovered from the resultant ash via leaching and purification in the existing scrap reprocessing facility. The leached ash is disposed of to a low level radioactive solid waste disposal site.

9.4 Site Description

Richland, along with Pasco and Kennewick, form the Tri-Cities metropolitan area in the southeastern portion of the State of Washington with a population of approximately 100,000. The Exxon Nuclear site lies just inside the northern boundary of the City of Richland on 320 acres. The fenced exclusion area is square shaped and lies on the north edge of the site. The center of the plant is approximately 930 feet south of the Horn Rapids Road which forms the northern boundary of the site.

The prevailing wind at the site is from the southwest, along the Yakima River corridor. Secondary wind directions are from the northwest and southeast. The average annual precipitation in the Richland area is 6.4 inches which is typical of a desert climate. The temperature falls below freezing approximately 100 days per year with an inch of snowfall on the average of twice each month during December and January. Maximum temperatures of 100°F or more are recorded during July and August.

The Columbia Basin is underlaid with thick sequences of basaltic lava flows. The region is in seismology zone 2. During the past 100 years, there have been three earthquakes of intensity, large enough to cause moderate damage to structures within 30 to 60 miles of the site, though no damage has been reported at the site.

The Exxon Nuclear site lies between the Yakima and Columbia Rivers. The flows of both rivers are regulated by multiple dams upstream of Richland. The site lies about 25 feet above the Columbia River level at Richland.

Groundwater occurs in unconfined sand and gravel aquifers approximately 20 feet below the surface at the site. The recharge of the shallow aquifer occurs chiefly from the Yakima River to the west.

A more detailed description of site characteristics is presented in document XN-14, Fuels Fabrication Plant Environmental Report.

9.5 Location of Buildings On-Site

The general layout and arrangement of the facilities/buildings at Exxon Nuclear is provided by Figure II-10.1. All facilities covered by this license lie within a fenced exclusion area. A detailed description of these facilities is contained in Chapter 10 of this document. Those structural facilities of significance which have been added since the last license renewal include a contaminated maintenance shop and a U_3O_8 conversion-storage facility connected to the UO_2 Building; a facility near Lagoon No. 4 for uranium recovery from liquid process wastes; a facility near Lagoon No. 1 for recovery of ammonia from liquid process wastes; an addition to the ELO facility to

house development activities; additional warehousing for special nuclear material; proprietary dry conversion equipment within the UO_2 plant and combustible waste incineration equipment within the Specialty Fuels Building.

9.6 Maps and Plot Plans

The relationship of the Exxon Nuclear site to neighboring buildings and the City of Richland is shown on Figure II-9.2.

The relationship of the Exxon Nuclear site to other population centers, land use features and geographic features are shown on Figures II-9.3, II-9.4 and II-9.5.

9.7 License History

License No. SNM-1227 was first applied for on June 15, 1970 and first issued by the U.S. Atomic Energy Commission on December 14, 1970. The license was revised in its entirety and reissued on July 18, 1974 with an expiration date of July 31, 1979. Application for license renewal was submitted on May 31, 1979. The license was renewed again on October 26, 1981 with an expiration date of October 31, 1986.

PART II - SAFETY DEMONSTRATION

Table II-9.1 Corporate Information

REV.

Office	Incumbent	State of Residence	Citizenship
President	S.J. Beard	Washington	U.S.A.
Vice-President	R.B. Stephenson	Washington	U.S.A.
Vice-President	P.W. Smith	Washington	U.S.A.
Vice-President	R.W. McCullugh	Washington	U.S.A.
Vice-President	D.G. McAlees	Washington	U.S.A.

EXXON NUCLEAR COMPANY, INC.

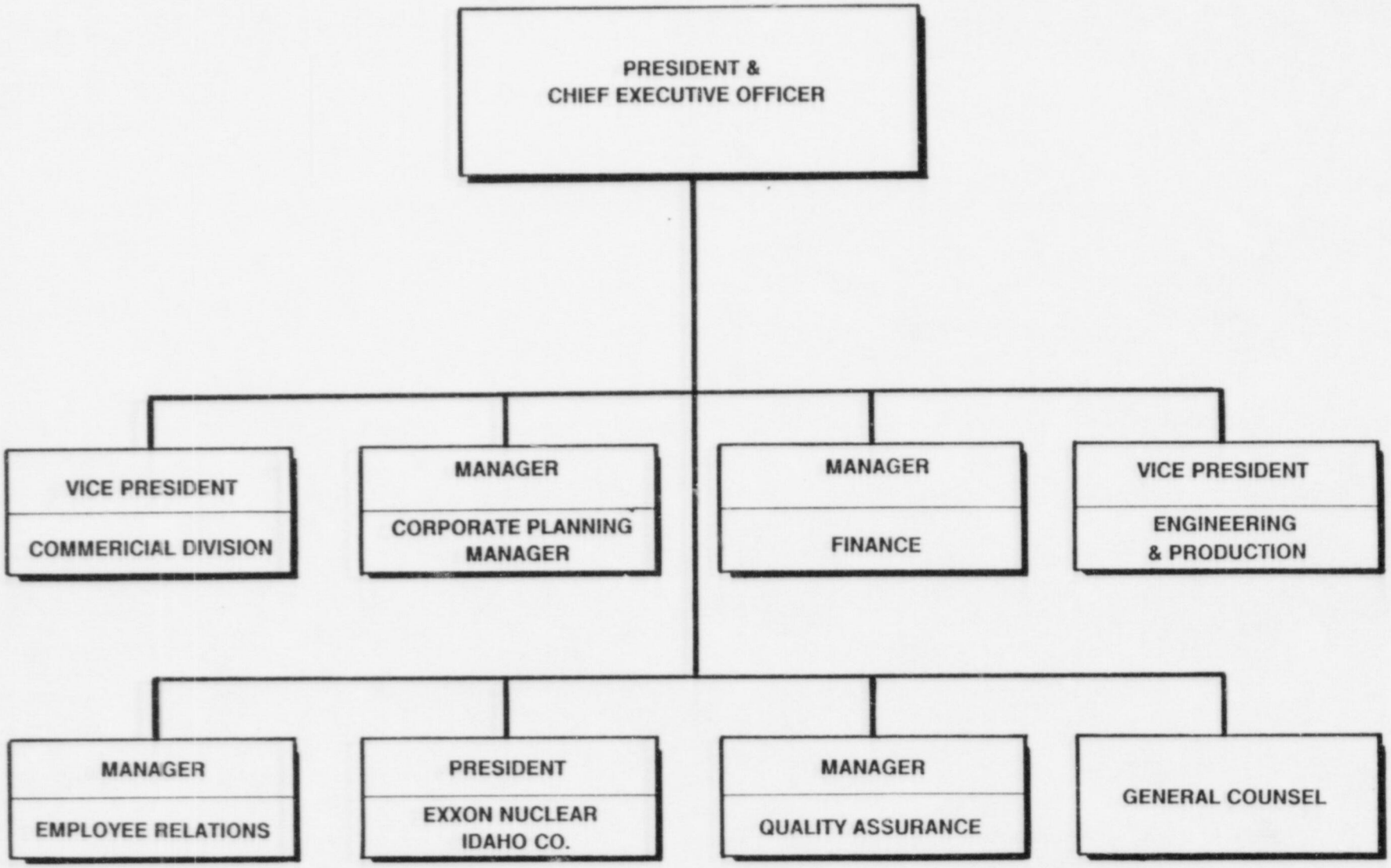
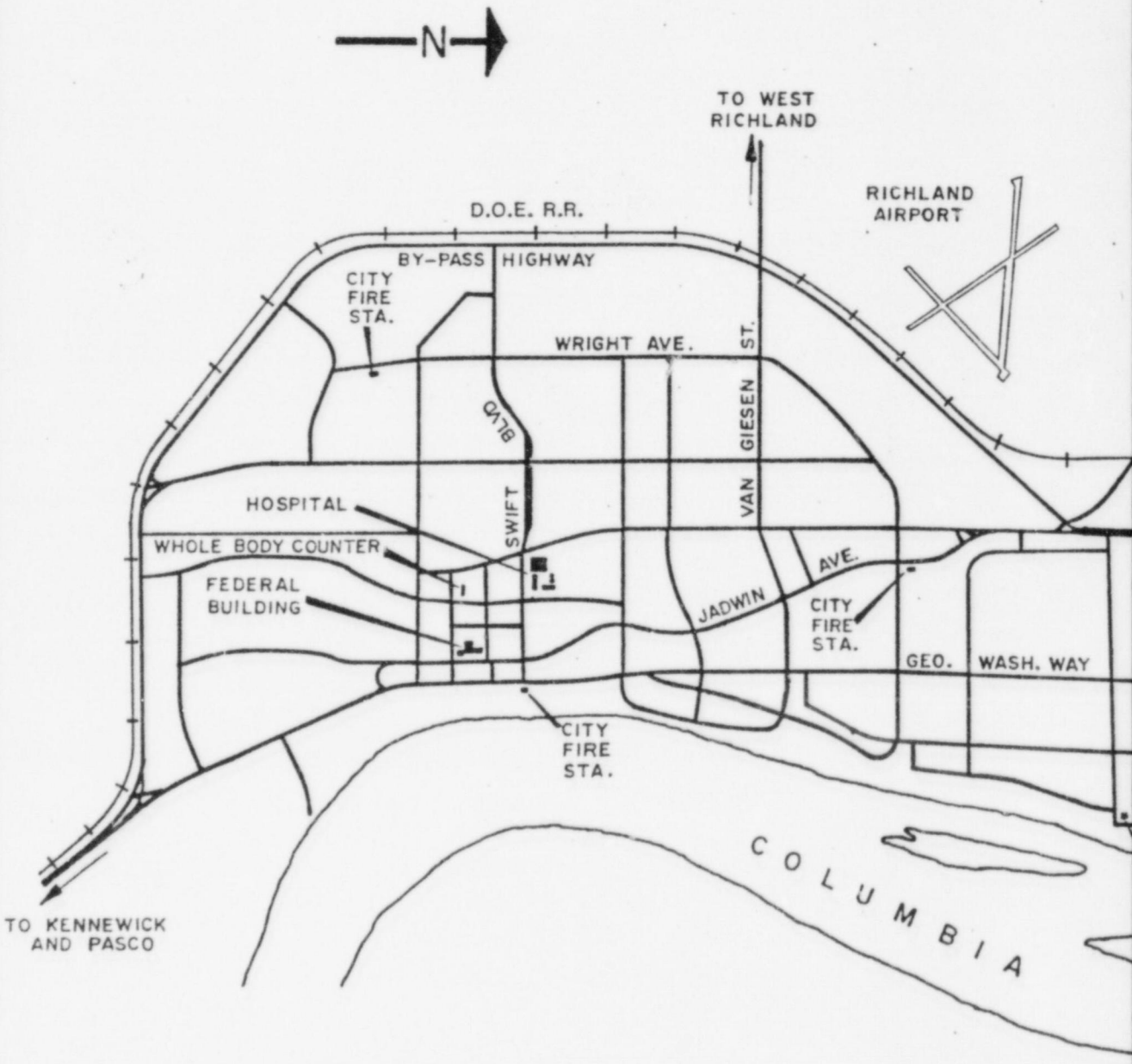


FIGURE II – 9.1



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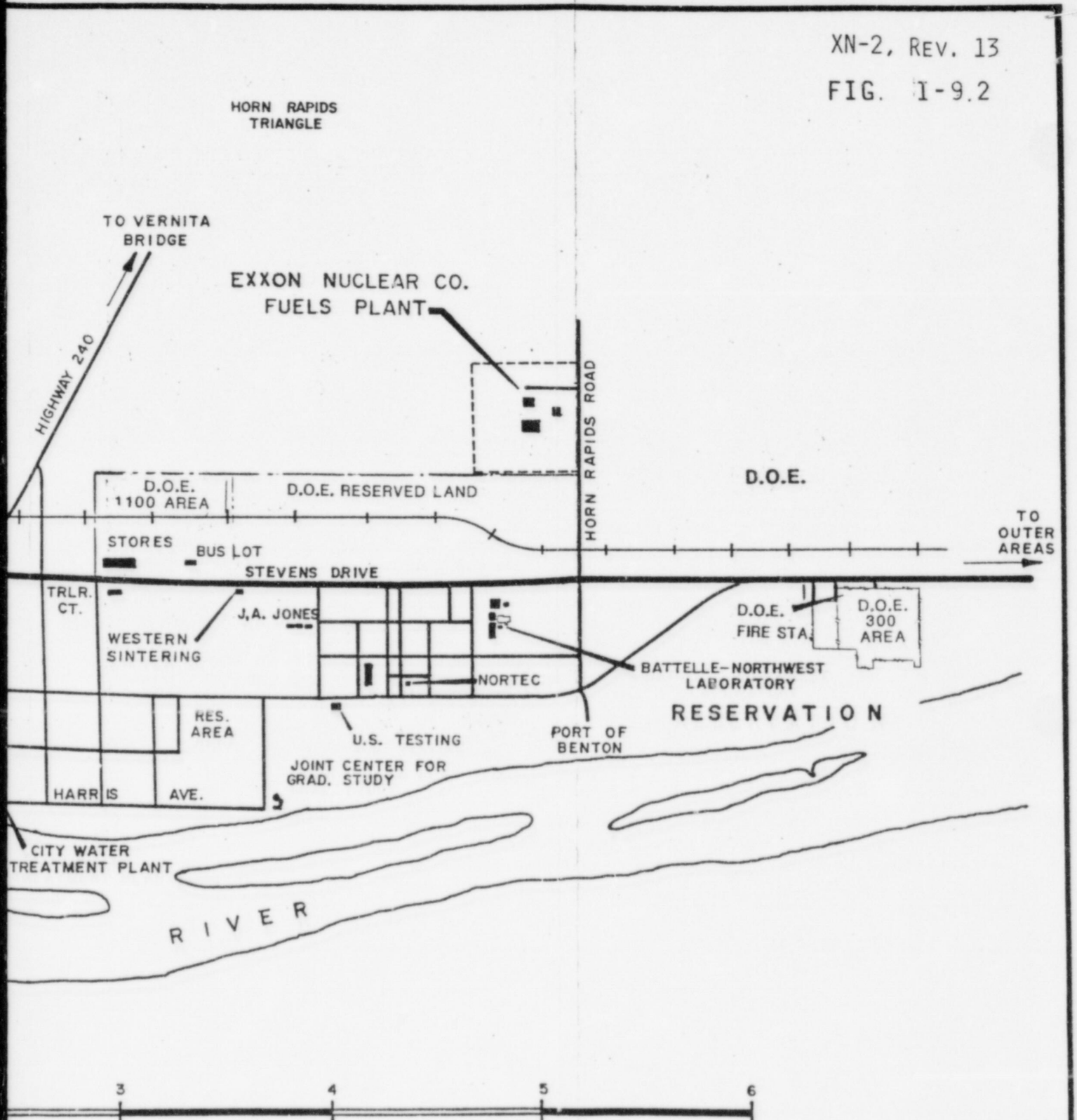
XN-2, REV. 13

FIG. I-9.2



RICHLAND AREA AND EXXON NUCLEAR CO. FUELS PLANT

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FIGURE II-9.3

LAND USE WITHIN 50 MILE RADIUS OF EXXON NUCLEAR SITE

(Reservations, Reserves, Recreational Areas & Parks)

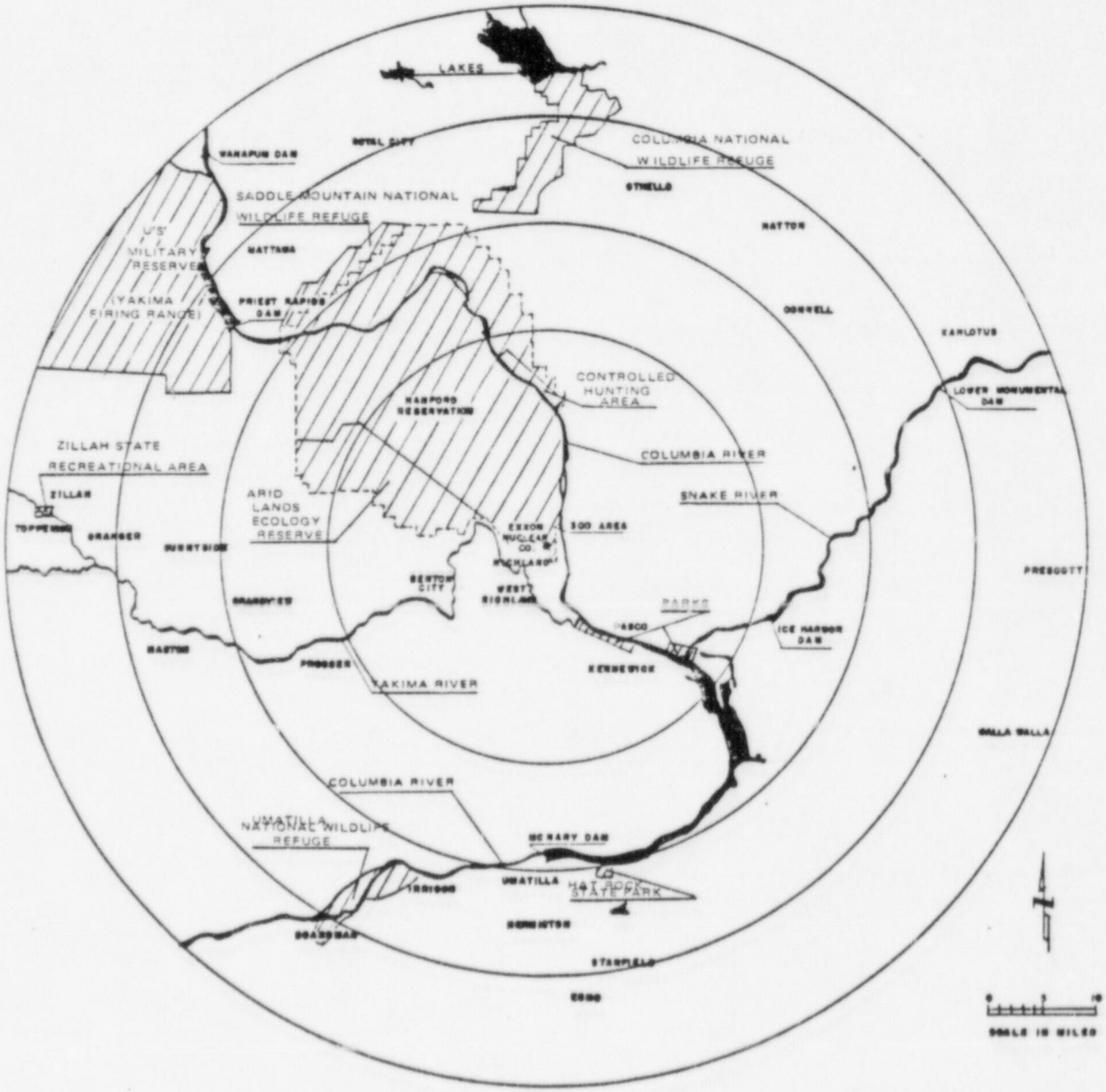

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FIGURE II-9.4

LAND USE WITHIN 50 MILE RADIUS OF EXXON NUCLEAR SITE

(Agricultural Areas)

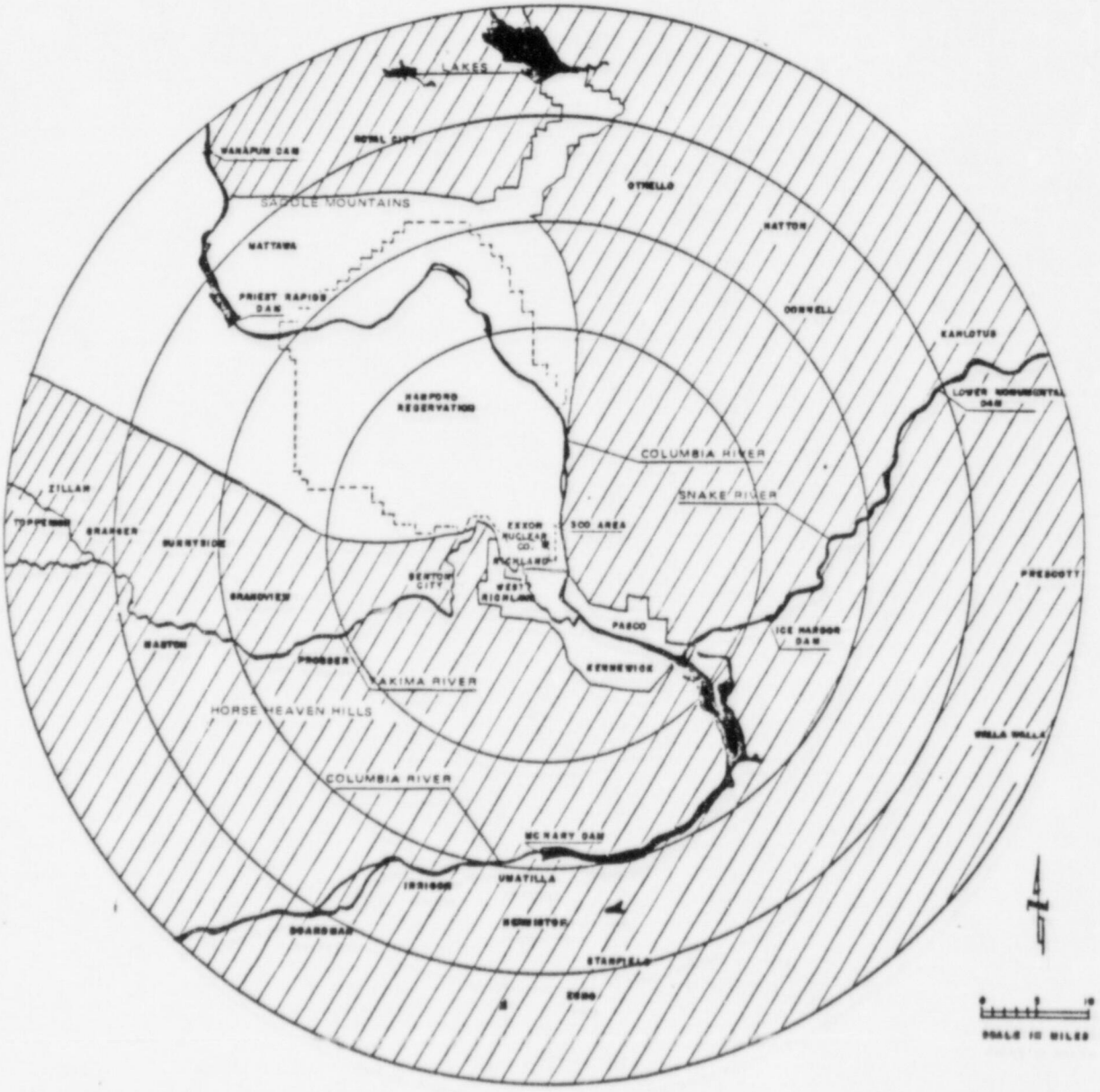
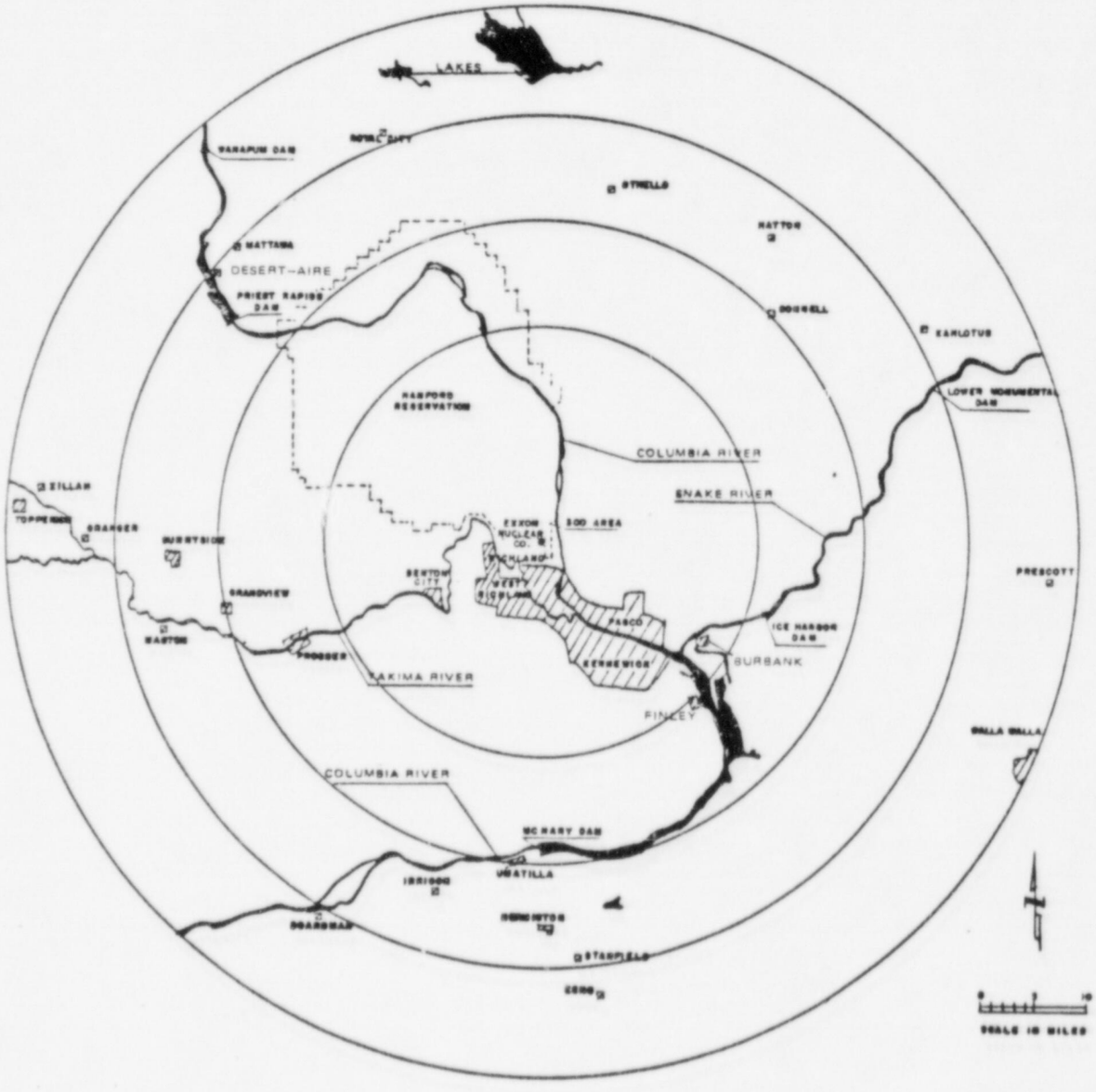


FIGURE II-9.5

LAND USE WITHIN 50 MILE RADIUS OF EXXON NUCLEAR SITE

(Cities, Towns & Residential Areas)



APPENDIX A

CHAPTER 9

CHAPTER 10

FACILITY DESCRIPTION

CHAPTER 10 FACILITY DESCRIPTION

10.1 Plant Layout

The Exxon Nuclear Fuels Facility at Richland, Washington consists of 24 buildings, plus various outside facilities which are shown on Figure II-10.1. Many of these buildings, such as the office complex, guardhouse, warehouse complex, etc., are not utilized for uranium processing and are not addressed further.

Those facilities which are involved with enriched uranium handling and processing, and are therefore covered under this license application, are listed below:

1. Specialty Fuels (SF) Building
2. Uranium Oxide (UO_2) Building
3. Engineering Laboratory (ELO) Building
4. Contaminated Clothing Laundry
5. Fuels Storage Warehouse
6. Radioactive Material Warehouse
7. Fuel Cooling Test Facility (FCTF)
8. UF_6 Receiving and Storage Facility
9. Lagoon Uranium Recovery (LUR) Facility
10. Ammonia Recovery Facility

A description of these facilities, including the licensed activities in each, follows. The LUR Facility and the Ammonia Recovery Facility will be described in Section 10.4, Radioactive Waste Handling.

All buildings and facilities on the Exxon Nuclear site were designed, constructed and inspected in accordance with the edition of the Uniform Building Code (UBC) current at the time of construction, the City of Richland Municipal Code, plus any special requirements as may have been dictated by their intended use. Unless otherwise indicated, the facilities were all designed to withstand UBC Zone II seismic loading and 20 lb/ft^2 windward pressure.

10.1.1 SF Building Description

The SF Building is two stories high (about 28 feet) with outside dimensions of 100 feet by 114 feet. The first and second floor plan views are shown on Figure II-10.2. The outside walls are 6-inch thick, precast, reinforced concrete slabs attached and sealed to reinforced concrete columns. The roof is made of steel deck plates supported on steel trusses and covered by a vapor barrier insulation, plus a 20-year built-up, low-melt asphalt roof with a final coating of gravel. The inner side of the precast wall panels are insulated and covered with fire-rated gypsum board. The gypsum panel joints

are taped and sealed and the interior surfaces are suitably painted. The compressive strength of all concrete will exceed 3000 psi and the 6-inch thick concrete floor slabs were designed for 250 psf. A storage vault 15 feet by 17-1/2 feet by 26 feet high occupies the northeast corner of the building. The vault is of reinforced concrete with a minimum wall thickness of 18 inches. A large airlock (18-1/2 feet by 28 feet by 14 feet high) made of concrete block is on the east side of the building and is used as the main entrance to the Solid Waste Uranium Recovery (SWUR) facility located in Room 173.

The first floor of the two-story section of the SF Building contains change rooms, an emission spectrometer, radiological safety facilities, and the lower half of the vault. The upper floor contains offices, a lunchroom, heating and ventilating equipment, and the upper half of the vault.

The main processing area is a high bay 76 feet by 100 feet with interior partitions for process control. The main processing area contains the SWUR facility, the nuclear absorber fuel (Gd_2O_3-UO_2) fabrication line, and a mass spectrometer.

Residual plutonium contaminated waste leftover after the decontamination, in 1985, of the Mixed Oxide (MO) equipment and Room 173 is stored in sealed containers in the storage vault.

The emission spectrometer in Room 164 is used to check impurity levels, while the mass spectrometer in Room 182 is used to check isotopic levels of the Exxon Nuclear fuel.

The Nuclear Absorber Fuel (NAF) rod fabrication facility is contained in Rooms 162, 163 and 174. The following processes are accomplished in this facility: Gd_2O_3-UO_2 blending, compaction, hammermilling, pellet pressing, pellet outgassing, rod loading, and rod welding. Pellet sintering is accomplished in the UO_2 Building, as well as all manufacturing steps after final end-welding of the rods.

The SWUR facility is located in Room 173. Solid waste, either from the storage yard or directly from the UO_2 Building, is brought into the SWUR facility where combustible and noncombustible products are sorted. The combustible waste is charged into the controlled air incinerator. The resulting waste ash is then taken to the UO_2 Building where the uranium is recovered using a leaching operation. The noncombustible waste is surveyed and either disposed of at a waste site or returned to the storage area for further processing.

10.1.2 UO_2 Building Description

The UO_2 Building is the main operating facility of the Exxon Nuclear plant, and houses the majority of the fuel fabrication activities. Since 1970 when the original building was constructed, there have been numerous additions, modifications, and expansions. The building, as it currently exists in 1986, will be described in this section. The footprint of the building is shown on Figure II-10.3.

The basic facility consists of a two-story high building, 133 feet wide by 367 feet long. Equipment room and administrative areas are located on the second floor at both the north and south ends of the building. An 80.5 feet by 112 feet two-story wing on the northeast corner houses line 1 and line 2 UF_6 conversion systems as well as other chemical operations. The outside walls of the UO_2 Building are 6-inch thick, precast, reinforced concrete slabs attached and sealed to reinforced concrete columns. The roof is made of steel deck plates supported on steel trusses and covered by a vapor barrier insulation, plus a 20 year, built-up, low-melt asphalt roof with a final coating of gravel. The inner side of the precast wall panels, except in the UF_6 conversion wing, are insulated and have a fire-rated gypsum board interior applied on furring strips. The gypsum panel joints are taped and sealed, and the interior surfaces are suitably painted. For ease in decontamination, the inner side of the wall panels in the UF_6 conversion wing have the concrete finished smooth and painted. The compressive strength of all concrete exceeds 3000 psi and the 6-inch thick concrete floor slabs were designed for 250 psf. The portion of the building south of column 19 was designed structurally for Zone 1 earthquake loadings (0.25 g) where the remainder of the building was designed for Zone II earthquake loadings (0.17 g). The interior partitions throughout the building are either concrete block or fire-rated gypsum board.

The U_3O_8 facility, located immediately south of the UF_6 conversion wing, is a two-story structural steel facility. The building is approximately 29 feet by 50 feet by 24 feet high. The exterior walls and roof are 24 gauge sheet metal, insulated and finished on the interior with fire-rated gypsum panels. Care was used in sealing the sheet metal and gypsum panels in order to maintain the required pressure differentials and airflows in the metal structure. All interior walls used for process control are fire-rated gypsum board on metal studs. All interior surfaces are taped and sealed and suitably painted. The first and second story floor slabs are 3000 psi concrete. The Powder Storage Facility, located south of the line 1 UF_6 conversion area is a high bay 24 feet by 50 feet by 24 feet high preengineered metal building. The exterior walls and roof are 24 gauge sheet metal, insulated and sealed. The floor slab was designed for 250 psf and made of 3000 psi concrete. The Tube Cleaning Room, located on the south end of the UO_2 Building, is a pre-engineered metal building 16 feet high by 24 feet by 40 feet. The exterior walls and roof are 24 gauge sheet metal, insulated and finished on the interior

with fire-rated gypsum panels. Interior partitions are fire-rated gypsum board on metal and/or wood studs. The gypsum panel joints are taped and sealed, and the interior surfaces are suitably painted. The floor slab was designed for 250 psf and made of 3000 psi concrete.

Figures II-10.4, II-10.5, II-10.6 and II-10.7 show the major equipment on both floors of the UF_6 conversion wing. The two conversion lines occupy Rooms 104, 105, 131 and 132 on the first floor, and Rooms 203, 204, 210 and 211 on the second floor. Exxon Nuclear currently uses the Ammonium Diuranate (ADU) process for the majority of its conversion work. The process consists of the following major steps: vaporization, hydrolysis, precipitation, centrifugation, drying and calcination. A proprietary, dry conversion system is also located in Room 104. The Miscellaneous Uranium Recovery System (MURS) is located in Room 104 and will be described in other sections of this Application. A solvent extraction system is located in Room 180A. A UNH facility, which is used to dissolve U_3O_8 or UO_2 in nitric acid to form uranyl nitrate, is located in Room 101A. The UO_2 powder lot blending, compaction and granulation is accomplished in Rooms 104 and 128; whereas lube blending is accomplished in Room 180. Exxon Nuclear's scrap recovery facility is located in Room 204.

The equipment locations and floor plans of the two-story U_3O_8 Facility and the Powder Storage Facility are shown on Figure II-10.8. The lower floor of the U_3O_8 facility is used predominantly as a maintenance shop for work on contaminated equipment. A small area of the lower floor adjacent to the powder storage area is partitioned off and is used to load drums with powder from the second floor. The second floor of the facility is used to convert scrap UO_2 to U_3O_8. The U_3O_8 is then screened and loaded into drums for storage or transport for further processing. The Powder Storage Facility is used to store sealed buckets or drums of dry materials including UO_2, U_3O_8, scrap, etc., awaiting further processing.

Figure II-10.9 is a plan view of Room 100 which is a high bay area and contains ceramic process equipment. The process flow starts at the north end of the room where the UO_2 powder is directed by hoppers to the pellet presses. The green pellets are processed through the sintering furnaces. The sintered pellets are then fed to the grinders, the wash station, dry station and then through the pellet inspection stations. Once the pellets are accepted, they are placed in pellet storage cabinets until needed for further processing. The Powder Characterization Facility is located in Room 100A at the south end of Room 100. The characterization facility contains the necessary equipment to conduct laboratory scale tests on each UO_2 powder lot.

Fuel rod tubing is processed through the Tube Cleaning Facility, Figure II-10.10, prior to insertion into the manufacturing stream. The tubing is cleaned and inspected before it is transferred to Room 182 for first-end welding. Figure II-10.10 also shows the equipment arrangement of the south equipment room and the administrative area on the second floor.

Figure II-10.11 shows the space and equipment devoted to the rod fabrication phase of the manufacturing process. Room 182 is a high bay area where Room 189 has headroom of approximately nine feet. Pellets are removed from the storage cabinets in Room 100 and processed through the outgas furnaces in Room 182. After the pellets are outgassed, they are loaded into first-end welded tubes in the rod loading gloveboxes. After rod loading, the second-end weld is made. The rods are then processed through the helium leak check, rod assay tester, and rod x-ray equipment which is all located in Room 189.

After the nondestructive testing in Room 189, the BWR fuel rods are transferred to Room 110, the Etch Room, shown on Figure II-10.12. The rods are cleaned in cleaning solutions and etched to remove any surface contaminants. Offgas from the etching equipment is exhausted through a scrubber and HEPA filters. After etching, the rods are transferred to Room 107 where they are processed through high-pressure, high-temperature autoclaves. The autoclaves are located in a reinforced concrete pit approximately 20 feet deep. After autoclaving, the rods are transferred through various inspection stations to the final rod storage area in Room 193. After the nondestructive testing in Room 189, the PWR fuel rods are transferred directly to the final rod storage area in Room 193.

The bundle assembly, cleaning, inspection and shipping container loading operations are all done in Room 193 shown on Figure II-10.13. Rods are moved from the rod storage area to the rod insertion tables. The fuel bundle is assembled on the bundle assembly table and is then lifted to the vertical position on the assembly table and moved onto the bundle inspection granite column. After inspection the bundle is cleaned, dried and is moved to the storage area or to the shipping container loading area where it is prepared for shipment. Immediately west of Room 193 is Room 195 where cage and spacer fabrication work is accomplished.

Figure II-10.14 shows the low bay area of the UO_2 Building that is devoted almost exclusively to the various quality control and inspection functions that are necessary in the manufacture of nuclear fuel. These areas and/or functions include a physical testing laboratory, metallurgical laboratories, and a limited number of offices.

The north end equipment room and administrative areas are shown on Figures II-10.15 and II-10.16.

10.1.3 ELO Building Description

The current ELO facility consists of an original building constructed in 1974, and an expansion constructed in 1982. The original facility consist of approximately 6000 square feet on the ground floor and about 3000 square feet in the basement. The addition, which effectively doubled the building size, utilized the same basic type of construction. The 1982 addition consisted of approximately 6000 square feet on the ground floor, and 4000 square feet in the basement. The entire ELO facility is currently operated as a single facility and will be treated as such in this Application.

The floor plan for the ELO facility is shown on Figure II-10.17. The basement areas are constructed of poured-in-place concrete walls and floor slabs. The ground floor construction, approximately 70 feet by 172 feet by 12 feet high, is of concrete block on poured-in-place skirt walls. The inner side of all exterior walls are insulated and covered with fire-rated gypsum board. The gypsum panel joints are taped and sealed, and the interior surfaces are suitably painted. The interior partitions throughout the building, used for process control, are either concrete block or fire-rated gypsum board. The roof is made of steel deck plates supported on steel trusses, covered with insulation and a 20-year, built-up roof system. The compressive strength of all concrete will exceed 3000 psi and the concrete floor slabs were designed for 250 psf.

The basement area of the facility contains an engineering machine shop, a solvent extraction area, and other engineering test facilities. The first or ground floor contains an instrument laboratory, metallography laboratory, wet chemical laboratories, and several engineering offices.

The uranium enrichment in the various laboratories is less than 20 wt% U-235 in solid form, and not more than 5 wt% U-235 in liquid form. Activities include all operational steps of fuel manufacturing and process testing.

10.1.4 Contaminated Clothing Laundry

The location of the laundry facility is shown on Figure II-10.1. The building is a preengineered metal building 12' high by 20 feet by 30 feet with a 6-foot, 9-inch by 17 foot, 9-inch airlock which provides for access, yet maintains the proper pressure differentials for contamination control. The exterior walls are 26 gauge sheet metal and the roof is 24 gauge sheet metal, insulated and finished on the interior. The interior of the roof is a suspended metal ceiling grid with acoustical lay-in panels 5/8-inch thick. The interior of the metal walls are finished with fire-rated gypsum panels. Interior partitions are fire-rated gypsum board on metal studs. Care was used in sealing the sheet metal and gypsum panels in order to maintain the required pressure

differentials and airflows in the metal structure. All interior surfaces are taped and sealed, and suitably painted. The floor was made of 3000 psi concrete and was designed for 250 psf.

Contaminated clothing is dry cleaned in a freon solvent system, surveyed for contamination and returned to use. Where clothing is essentially free of contamination but remains badly soiled it may then be water washed and the effluent directed to retention tanks which are sampled prior to being emptied to the site lagoon system. After cleaning, the clothing is again surveyed and returned to use.

10.1.5 Fuels Storage Warehouse

The location of the Fuels Storage Warehouse is shown on Figure II-10.1. The building is a preengineered metal building 60 feet by 40 feet by 16 feet eave height. The exterior walls are 26 gauge sheet metal and the roof is 24 gauge sheet metal. The interior of the walls and roof are fully sealed with closure strips and insulated. The floor slab was made of 3000 psi concrete and was designed for 250 psf.

The warehouse is used for the storage of packaged special nuclear material in various compounds and forms.

10.1.6 Radioactive Material Warehouse

The location of the Radioactive Material Warehouse is shown on Figure II-10.1. The building is a preengineered metal building 50 feet by 140 feet with 16 foot eave height. The exterior walls are 26 gauged sheet metal and the roof is 24 gauge sheet metal. The interior of the walls and roof are fully sealed with closure strips and insulated. The floor slab was made of 3000 psi concrete and was designed for 250 psf.

The warehouse is used for the storage of packaged special nuclear material in various compounds and forms.

10.1.7 Fuel Cooling Test Facility (FCTF)

The location of the FCTF is shown on Figure II-10.1. The building is a high bay, 29 foot eave height, preengineered metal building, 40 foot by 40 foot. The exterior walls are 26 gauge sheet metal and the roof is 24 gauge sheet metal. The interior of the walls and roof are fully sealed with closure strips and insulated. A concrete pit, 15 foot by 8 foot by 18 foot deep, inside the building provides space for various test vessels and piping systems. All concrete used in the construction of the building had 3000 psi compressive strength and the floor slab was designed for 250 psf. A 3-ton bridge crane and hoist services the entire interior of the building. Adjacent to and

constructed as part of the main building is a 40 foot by 20 foot by 12 foot high addition made of the same material as the main building which houses the process boiler.

The facility houses a hydraulic test loop that is used to determine heat transfer performance of nuclear fuel assemblies during spray and reflood cooling following a postulated loss-of-coolant accident (LOCA).

10.1.8 UF_6 Receiving and Storage Facility

The location of the UF_6 Receiving and Storage Facility is shown on Figure II-10.1. The complete facility consists of: 1) an open air 5-ton bridge crane and hoist supported by a steel structure which operates over an area of 165 feet by 25 feet; 2) a 10 foot by 10 foot by 10 foot high sheet metal scale house; and 3) approximately 8500 square feet of asphalt area used for storage of UF_6 cylinders.

The open air bridge crane is used to load and unload UF_6 cylinders onto and off of semi trucks. The crane structure provides an under-crane storage area of about 4000 square feet where the UF_6 cylinders can be moved about using the 5-ton crane and hoist. The truck access bay and a total of about 1700 square feet is provided with a sheet metal rain cover. The scale house provides a weatherproof structure for the certified scales used to weigh full and empty UF_6 cylinders. An additional asphalt storage area of about 4500 square feet is provided immediately adjacent to the crane structure where UF_6 cylinders can be handled with a forklift. The entire facility provides load, unload and storage capabilities for up to 180 UF_6 30A and 30B cylinders.

10.2 Utilities and Support Systems

In the day-to-day operation of a nuclear fuels fabrication plant, many utilities and support systems are required. Utilities are required for the manufacture of the fuel and for the protection and safety of the product as well as the employees. A brief description of the following utilities and/or services will be provided in this license application:

1. Electric Power
2. Compressed Air
3. Water
4. Sanitary Sewer System
5. Gas and Chemical Storage
6. Communications and Annunciations
7. Breathing Air

10.2.1 Electrical Power

The electrical power for the Exxon Nuclear plant site is provided by the City of Richland industrial system. In addition, Exxon Nuclear has installed a standby emergency system to supply certain plant power needs in the case where the municipal system fails. Both systems are described in this section.

10.2.1.1 Utility (Normal) Supply

The "normal" supply is a 12.5 kV underground cable which connects to a City of Richland substation bus dedicated to north side industrial loads. The bus is directly supplied through two breakers and a transformer from a 115 kV Bonneville Power loop. The 115 kV loop is in turn supplied by Columbia and Snake River hydroelectric generation.

The "normal" 12.5 kV cable forms an underground loop within the Exxon Nuclear plant site, and each plant building supply is tapped into the loop through a three-phase, 12.5 kV grounded-wye to 480/277 volt grounded-wye transformation.

10.2.1.2 Standby (Emergency) Supply

The standby "emergency" supply is provided by three 225 kW and one 30 kW, three-phase, grounded-wye connected generators driven by diesel-fueled gas turbines. The turbine ignition and battery-driven starters are automatically energized on a loss of normal supply voltage indication. The direct-connected fuel pump drains diesel fuel at a positive head from an elevated day tank. Diesel fuel is stored in a 3000-gallon underground storage tank outside the building with a day tank inside the building.

The hydraulic-speed governor is set to give 60 cycle voltage and the solid state electronic voltage regulator is set to control the generator output at 470 volts.

The three 225 kW turbine generators are located in the north, south and east equipment rooms of the UO_2 Building and can supply power through automatic transfer switches to local emergency buses. The 30 kW generator, located west of the Specialty Fuels Building, supplies three-phase power to the security radio and emergency lighting in the Security Guard Building.

In the case of a turbine generator failure, the north generator or the south generator can be connected by manual switching to supply both emergency buses. Some less critical loads must be switched off on both buses.

10.2.1.3 UO_2 Building

Normal 480/277 VAC power is brought into the UO_2 Building through separate loop-tapped transformers located at the north, south and east side of the building.

The north end transformer secondaries (2) supply a 2000 amp, three bus panelboard (inside the building) and a 4000 amp, three bus panelboard (located in a switch cubicle outside the building) which distribute 480/277 VAC, three-phase power to the north half of the building through local distribution panelboards.

An additional 400 amp, 480/277 VAC, three bus panelboard dedicated to critical loads and identified as "north emergency panelboard" is supplied through an automatic transfer switch which, on loss of "normal power", switches the critical loads to the "standby" generator.

The loads currently assigned to the north emergency panelboard "E" are:

1. UO_2 Building (North)

- K-3 and K-9 Exhaust Fans
- K-10 (POG)
- Instrument Air Compressor and Dryer
- Standby HVAC Pneumatic Control Air Compressor
- Air Sampling Vacuum Pump
- Recirculating Air Radiation Detector
- Selected Personnel Survey Instrumentation
- Criticality Detector and Warning System
- Emergency Lighting
- Annunciator Power
- HVAC Control Power
- Emergency Generator Battery Power
- Day Tank Diesel Fuel Pump
- Exhaust Duct Deluge System
- Sintering Furnace Line Nos. 1, 2, 3 and 4 Control Power
- Combustible Gas Detector
- Safety Shower Lights
- Calciner Rotation (UF_6) Line No. 1 and Scrap Recovery

2. Specialty Fuels (SF) Building

- Process Drain Retention Tank Sampling Pump
- Emergency Lighting
- K-6 Exhaust Fan
- Standby HVAC Pneumatic Control Air Compressor
- Deluge System

- HVAC Control Power
- Safety Shower Lights
- Annunciator
- Criticality Detector and Warning System
- Recirculation Air Radiation Detector
- Battery Charger Security Alarm
- Gas Analyzers (O_2, H_2, combustible gas)
- Office Building No. 1

A south end transformer secondary supplies 4000 amp, 480/277 volt three-phase incoming switchgear which distributes 480/277 volt three-phase power to the south half of the building through distribution panels.

A 600 amp, three-phase, 480/277 volt bus, designated as Emergency Motor Control Center (MCC-E-1), is supplied by an automatic transfer switch which upon loss of "normal" power will instigate an automatic transfer of the MCC-E-1 loads to the oncoming turbine generator.

The loads currently assigned to the south emergency system MCC-E-1 are:

1. UO_2 Building (South)

- Compressor Recirculation Pump K22
- Air Sampling Vacuum Pump
- Emergency Lighting
- Instrument Air Compressor
- Turbine Generator Fuel Pump
- Air Dryer and Compressor Cooling Water Control
- Exhaust Duct Deluge System
- Turbine Generator Battery Charger
- Office Building No. 5 Telephone System
- Autoclave Sump Pump
- Combustible Gas Detector

The east end transformer secondary supplies 400 amp, 480/277 volt three-phase incoming switchgear which distributes 480/277 VAC three-phase power to the east side (Line 2 conversion) of the building through distribution panels.

A 600 amp, three-phase 480/277 volt bus, designated as Emergency Motor Control Center "NE" is supplied by a 600 amp "normal" feeder from the incoming switchgear by way of an automatic transfer switch. Loss of "normal" power will instigate an automatic transfer of the MCC-NE loads to the oncoming emergency generator.

The loads currently assigned to the east emergency generator system MCC-NE are:

1. UO_2 Building (East)

- Exhaust Fan K-31
- Exhaust Fan K-32 (POG)
- Air Sampling Vacuum Pump
- Emergency Lighting
- Calciner Cylinder Drive
- Calciner Rotary Airlock
- Line 2 Switchgear (emergency control power)
- Uninterruptible Power Supply (UPS) for MICON System
- Vaporization and POG Scrubber Line 2
- Instrument Air Dryer
- Deluge System
- Emergency Generator Battery Power
- HVAC Control Panels
- Combustible Gas Detector
- Line 2 Vaporization Room Header Heaters Zones 1, 4, 5 and 6

10.2.1.4 SF Building

Normal power is brought into the SF Building from a 12.5 kV tap on the plant loop, transformed to three-phase, 480/277 VAC, grounded-wye and supplied to 800 amp, 400 amp and a 300 amp switchgear through a 2000 amp fusible ground fault protected disconnect outside the building.

Critical loads are supplied from a distribution panelboard, which is connected by underground cable to the UO_2 north emergency panelboard.

10.2.2 Compressed Air System

The plant's compressed air system is actually four systems: 1) normal plant air; 2) instrument air; 3) control air; and 4) emergency air.

The nuclear fuel manufacturing portion of the plant's normal compressed air needs are supplied by three compressors located in the Compressor Building, shown on Figure II-10.1. These compressors supply air to the UO_2 Building, SF Building, ELO Building, and the Ammonia Recovery Facility. Other facilities, such as the Maintenance Building, Machine Shop, and FCTF Building, have small compressor units to serve their individual needs.

Two of the compressors in the Compressor Building are 500 CFM dry ring units, and the third compressor is a 280 CFM rotary which provides a total capacity of 1,280 CFM for the manufacturing portion of the plant. All

three units are classified as "oil free". Normal plant demand is satisfied by running any two of the units with the third on standby. The system pressure is maintained at 115 psig.

Normal compressed air is supplied to air dryers located in the north, south and UF_6 equipment rooms of the UO_2 Building, and in the Ammonia Recovery Facility. The dryers dry the air to a dewpoint of -40°F and it is then distributed as instrument air.

Instrument air is reduced in pressure to 20 psig to be utilized as HVAC and process equipment control air.

In the event of an electrical power outage, the plant's emergency air system will function. The emergency system consists of the 280 CFM unit in the Compressor Building, a 42 CFM unit in the north equipment room of the UO_2 Building, and a 34 CFM unit in the south equipment room of the UO_2 Building. All three of these units are connected to the plant's emergency power system. The 280 CFM compressor provides air to the plant until the various systems can be safely shut down. The smaller units in the equipment rooms are devoted exclusively to the HVAC systems to provide sufficient operating and control air to allow the system to be shutdown safely or to continue to operate in the emergency mode.

10.2.3 Water

The water supply to the Exxon Nuclear plant is furnished by the City of Richland. The source of water for the City is the Columbia River. Wells, which were the earlier source of water for the City before construction of the present water filtration plant on the river, has been kept in condition as a secondary backup source. Primary backup is furnished by a 15 million gallon equalizing reservoir on a bluff south of the City at an elevation of 545 feet.

Water is supplied to the plant via two lines from the north city water grid into the plant's water loop. The City of Richland's Water Department has assured Exxon Nuclear that each main line would supply in excess of 1500 gpm at 40 psig for a total capacity in excess of 3000 gpm through both lines. Actual flow measurements taken during the entire year of 1985 show that the maximum water required by the plant was approximately 400 gpm with a yearly average of 286 gpm.

The plant's total water usage averages 31 gpm of sanitary water, and 25[illegible] gpm of process water. Approximately 42 gpm (maximum usage) of the process water is further refined as deionized water for various product and laboratory uses.

Since both sanitary and process water needs are taken from the same inlet waterline, vacuum breakers are installed to provide assurance that process water cannot backflow into either the City system, or into the plant sanitary water system. Figure II-10.18 shows the main waterlines into and around the Exxon Nuclear plant.

Due to the redundant backup systems for the City's water supply, the probability of complete loss of water supply is extremely small. Since the water is supplied to the Exxon Nuclear plant by a complete loop with a number of sectionalizing and isolation valves, the probability of a water outage due to a main pipe breakage is also considered extremely remote. Even if a complete water outage did occur, the only possible damage to the plant would be to the sintering furnaces and would not present a radiological or containment problem.

10.2.4 Sewer System

Sanitary wastes from the office buildings, as well as from the production buildings, flow to a sanitary drainage system leading directly to the Richland Municipal Sewer System. Change room showers are not used for personnel decontamination, but are for employee convenience only. Employees are required to conduct a self-survey as they enter the change room.

Water is used for cooling purposes throughout the manufacturing facilities in various amounts, depending on the specific process, equipment, and operation in progress. Process cooling water is isolated from the actual process atmospheres by double, physical barriers, and discharged to the sanitary sewer system.

Liquid chemical wastes, process cooling wastes, and sanitary wastes are combined and flow through the flowmeter-sampling station where a composite sample is automatically taken of all flows to the municipal sewer system. The composite sample is analyzed daily Monday-Friday. Figure II-10.18 shows the main pipelines of the sewer system.

10.2.5 Gas and Chemical Storage

The sintering furnaces and the calciners in the UF_6 conversion areas are provided with a reducing atmosphere by the use of a hydrogen-nitrogen mixture derived from liquid nitrogen and cracking anhydrous ammonia in dissociators. Pressure tanks for anhydrous ammonia and liquid nitrogen are provided on the outside of the buildings. Outside cylinder storage is provided for gases such as helium, argon, oxygen, acetylene, hydrogen, and propane.

Liquid chemicals used in the process such as nitric acid and sodium hydroxide solution are stored in outdoor tanks near the point at which they are consumed. The chemical storage tanks are diked such that spillage or leakage is contained. The dikes do not drain to sewer; however, they may be pumped to sewer if so dispositioned.

Solvents are used principally for cleaning components. Other than quantities required for normal use, solvents are stored in the Chemical Storage Building.

10.2.6 Communications and Annunciations

Full telephone service is provided for every building and facility on the Exxon Nuclear site. Most of the telephones in the various offices are individual, direct-line telephones, whereas most of the telephones in the production area are serviced by an operator-attended switchboard.

Annunciation, both visual and audible, of off-standard conditions in the UO_2 and SF Buildings is provided in the reception area of each building. Typical conditions that are annunciated include:

Condition	UO_2 Bldg.	SF Bldg.
Fire Alarm	X	X
Emergency Power Mode	X	
Various HVAC Malfunctions	X	X
Criticality Alarm	X	X
Autoclave Sump Pumps	X	X
Sintering Furnace Malfunction	X	
Autoclave Malfunction	X	
Office Building Malfunction	X	
SF Building Malfunction	X	
Low Water Pressure	X	X
High Radiation, HVAC	X	X
Low Fire Main Pressure	X	
Cooling Tower Malfunction	X	

(These conditions are typical and are not intended to be exclusive as various changes and modifications will require new and different annunciation items.) Any indication of an off-standard condition in the UO_2 or SF Building is also signaled at annunciator panels in the Central Guard Building which is manned at all times.

A direct-line emergency telephone system provides an emergency telephone in the residences of specific key management personnel. These telephones are extensions of the plant phone system and permit calls to be made directly from the plant to members of the Exxon Nuclear emergency cadre.

Cycling klaxon howlers are provided to indicate the occurrence of a criticality event. Multiple strike gongs (two strokes per second) are provided to indicate fire. A public address system is installed for special messages or instructions. All three sets of audible signal devices are provided in sufficient numbers to be heard in all parts of the buildings and nearby outside areas.

10.2.7 Breathing Air

The major portion of the breathing air requirements are satisfied with the use of Self-Contained Breathing Apparatus (SCBA). The units in use by Exxon Nuclear are MSA-401. In addition to the SCBA's, there are three small permanently installed breathing air systems. The systems use 220 cubic foot air bottles and are located as follows:

1. A five-bottle system located in Line 1 conversion area servicing the vaporization room and the hot oil dryer;

2. A five-bottle system located in Line 2 conversion area servicing the vaporization room, the hot oil dryer, and the dry conversion area; and

3. A three-bottle system located in the contaminated maintenance area of the U_3O_8 Building servicing the welding table.

10.3 Heating, Ventilation and Air Conditioning (HVAC)

10.3.1 Criteria

The HVAC systems have been designed, and are operated, in conformance with Part I, Chapter 5 of the Special Nuclear Material license. HVAC systems, in those facilities which are involved with uranium handling and processing, have the following basic characteristics:

1. The HVAC system is refrigeration-cooled and electrically heated.

2. Air enters the process areas near the top of the rooms and exits near the floor.

3. Partial air recirculation may be used to reduce thermal loads.

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4. When air is reused, it moves from areas of lower potential airborne contamination, to areas of higher potential airborne contamination.

5. Provisions are made for continuous monitoring of the airflow in air recirculating systems, and an indication of airborne concentration exceeding eight MPC-hours ahead of the second filter, automatically shuts off supply air fans, and switches the system to a once-through exhaust mode.

6. Recirculated air from areas of no contamination is passed through roughing filters prior to return to the work spaces.

7. Recirculated air from areas of low potential contamination is passed through HEPA filters prior to return to the work spaces. No air is recirculated from process equipment hoods or enclosures.

8. Exhaust air from production areas with a potential of contamination is passed through HEPA filtration with an in-place filter bank efficiency of greater than 99.95% for a 0.8 micron particle DOP or DOS test. Exhaust air from process equipment enclosures or POG systems is double-HEPA filtered prior to exiting the facility.

9. Air changes are at least seven per hour in uranium processing areas.

10. The process areas are compartmentalized.

11. The HVAC system has been designed so that supply fans cannot be started until the proper exhaust duct negative pressure has been obtained.

12. Supply and exhaust fans are interlocked so that the supply fan is shut off upon exhaust fan failure.

13. Uranium processing areas are maintained at a negative pressure to atmosphere and adjacent clean areas.

14. Continuous isokinetic air samplers are installed in the exhaust systems downstream of the final HEPA filter.

15. Rate-of-rise heat detectors are installed in exhaust ducts and set to trip filter bank fog deluge systems at temperatures of 140-190°F.

16. Visual indicators for reading the pressure drop across all HEPA filters are permanently installed.

17. Connections are provided for in-place DOP/DOS efficiency filter testing of all final HEPA filters.

10.3.2 SF Building HVAC Systems

The SF facility has two independent building HVAC systems. The SWUR facility, located in Room 173, is basically a "once-through" HVAC system (K48 and K49) serving Room 173 and the adjacent airlock. The remainder of the production facilities, laboratories, change rooms and office section is served by a combination (K5 and K6) "once-through" and recirculation supply and exhaust system. Simplified schematics of these HVAC systems are furnished in Figures II-10.19 (SWUR K48 and K49 HVAC systems) and II-10.20 (SF production area K5 and K6 HVAC systems).

10.3.2.1 SWUR HVAC System

The general features of the SWUR HVAC systems (Figure II-10.19) are a "once-through" ceiling-to-floor airflow, supply air system, and a two-stage HEPA filtered exhaust system.

10.3.2.1.1 K48 Air Supply System

The K48 air supply system supplies about 6,600 ft^3/min of 100% outside air to the SWUR processing area and adjoining airlock. Each room has a minimum of seven air changes per hour. Downstream of the fan are duct air monitors for measuring airflow quantities. Airflows are directional from ceiling to near floor exhaust air grills, or process hood inlets, and always from areas of low contamination potential to areas of higher contamination potential.

10.3.2.1.2 K49 Air Exhaust System

Air supplied to Room 173 and the airlock, plus infiltration (approximately 7500 ft^3/min), is exhausted through the K49 exhaust system. The double HEPA filter arrangement in this system consists of the final HEPA filter bank and individual or smaller filter banks of prefilters and HEPA filters located in the exhaust ducts of areas or process equipment serviced.

The K49 system exhaust air passes from the final filter bank through a duct air monitor (measures airflow quantities), the main exhaust fan, and is discharged from a stack located on the SF Building roof. The stack extends 20 feet above the roof of the SF Building, or 50 feet aboveground elevation.

The K49 exhaust system has one full capacity fan which is connected to normal power. All final HEPA filters were in-place tested and assured to be 99.95% (minimum) efficient for 0.8 micron DOP/DOS cold aerosol.

10.3.2.1.3 Systems Controls

The HVAC systems are elaborately controlled with temperature, pressure and flow sensor actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The K48 supply air system is interlocked with the K49 exhaust system to prevent operation of the K48 supply air system without the K49 exhaust system operating. Pressure sensors are provided for damper control to maintain a negative pressure (minimum -0.05 inches water gauge) in the process areas relative to atmosphere.

Automatic audio and visual alarms are activated when any supply or exhaust system upset occur. Pressure differential indicating devices and airflow quantity meters are located in the controlled zones and/or on the main HVAC panel to provide system and zone operating conditions. Air samplers are located upstream and downstream of the final HEPA filters.

10.3.2.1.4 Deluge System

A deluge system of fog spray nozzles is installed in the exhaust ducts a short distance upstream of the final filter banks. If heat detectors indicate a temperature of 140-190°F, the deluge spray is automatically activated. The deluge system will protect the final banks from burning debris and heated air that would damage the mastic used to cement the filter media to the filter frame. Should the deluge system be activated by any circumstance, differential pressure readings across the final filters will be taken and an in-place DOP/DOS test made at the earliest opportunity.

10.3.2.1.5 Final Filter Bank

The final filter bank is encased in a sheet metal housing that, in turn, is fastened and sealed to a concrete slab. HEPA filters rated at 1000 ft^3/min at one-inch H_2O pressure drop are mounted in welded steel structural frames. The HEPA filter medium is 100% moisture resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet, or exceed, Military Specification MIL-F-51079.

10.3.2.2 SF Building Production Area HVAC System

The general features of the SF Building (K5 and K6) HVAC system are a partially recirculated air, downdraft airflow, and a two-stage HEPA filtered exhaust system. A simplified schematic diagram of the SF Building HVAC system is shown in Figure II-10.20.

10.3.2.2.1 K5 Air Supply System

The K5 system supplies air to the service areas of the building and the fabrication areas not serviced by the SWUR facility systems. The K5 system provides approximately 26,000 ft^3/min of air. Approximately 5,000 ft^3/min is recirculated from the service/office areas, and about 3,000 ft^3/min from the NaF area to reduce thermal loads in normal operation.

The design is such that air moves from clean areas to areas of contamination potential. Recirculated air from the NaF area is passed through two stages of HEPA filtration, the final bank of which will have an installed tested efficiency of 99.95% for 0.8 micron DOP/DOS particles. Provision is made in the K5 recirculation system for continuous radiation monitoring of recirculated air prior to the second HEPA filter. An indication of an airborne concentration exceeding eight MPC-hours automatically shuts down the K5 supply fan and places the K5 system on a once-through basis with the air exhausting through the final exhaust filters and stack. Return-air from the service and office areas passes through a roughing filter and mixes with NaF recirculated air prior to passing through the recirculation HEPA filter bank.

In all process areas, the airflow is directional. Supply is introduced from diffusers in the upper portion of the rooms, and exhaust air (including recirculated air) is drawn through HEPA filters in housings located near floor level. Air is also exhausted through hoods; however, there are no overhead exhaust outlets.

Also, to minimize the potential of contamination spreads, the fabrication area is compartmentalized. Each area is provided with floor level exhaust outlets (through HEPA filters) such that potential contamination would be localized to the room in which it might originate.

10.3.2.2.2 K6 Air Exhaust System

The SF Building production facilities, laboratories, change rooms, and related areas, are served by the K6 exhaust system. The filter arrangement in this system consists of two parallel final HEPA filter banks and individual or smaller filter banks of prefilters and HEPA filters located in the exhaust ducts of areas or process equipment serviced.

The final filter arrangement consists of two separate and parallel filter housings discharging to a common duct leading to the stack. One filter house contains a bank of HEPA filters preceded by a bank of 35% ASHRAE roughing filters. Air exhausted from the change rooms, NaF area, and a portion of the rod loading and analytical laboratory is passed through this series of filtration stages prior to discharge. Also, following prefiltration through individual combined HEPA and roughing filters, air exhausted from the analytical

laboratory, radiation monitoring offices, and storage area is introduced to this filter house between the banks of HEPA and 35% filters, and is drawn through the final bank of HEPA filters and discharged.

The second of the final filter houses contains one bank of HEPA filters. Air from the remainder of the process areas is drawn through upstream individual combined HEPA and roughing filters and drawn through this final HEPA filter and discharged. Room air exhausted from the NaF area, which is prefiltered through individual combined HEPA and 35% filters and normally recirculated, will be diverted upon detection of eight MPC-hours of radioactive material by the in-line radiation detector, to this filter house, and will be drawn through the final bank of HEPA filters and discharged.

Normaliy, when part of the air is being recirculated through the K5 supply system, the K6 system exhausts approximately 16,000 ft^3/min to atmosphere; if the entire HVAC systems were on a once-through operation, approximately 26,000 ft^3/min would be discharged.

The K6 exhaust air passes directly from the final filter banks to the exhaust fans and is discharged from a stack extending 50 feet aboveground elevation. The K6 exhaust system has two full-capacity fans which are used alternately to provide standby capability. Both fans are connected to normal and emergency power.

10.3.2.2.3 System Controls

The HVAC system is elaborately controlled with temperature, pressure and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The individual systems are interlocked so that one of the K6 exhaust fans must be started before the supply system (K5) can be started. In the event of power failure, K6 fans are automatically transferred to an emergency electrical bus.

As long as the supply and exhaust plena pressures remain in the established ranges, the building pressure differentials will be maintained. All main duct HEPA filters are provided with differential pressure indicators. Sudden changes in differential pressure across a final filter bank, indicating either excessive filter plugging or a filter rupture, alarms automatically on the main annunciator panel.

10.3.2.2.4 Deluge System

A deluge system of fog spray nozzles is installed in the exhaust ducts a short distance upstream of the final filter banks. Should the deluge system be activated by any circumstance, differential pressure readings across the final filters will be taken and an in-place DOP/DOS test made at the earliest opportunity.

10.3.2.2.5 Final Filter Banks

The final filter banks are encased in sheet metal housings that, in turn, are fastened and sealed to a concrete slab. HEPA filters rated at 1000 ft^3/min at one-inch H_2O pressure drop are mounted on special American Air Filter clean room frames. Individual filter frames that are normally used for clean room systems are welded together to form integral frames of the required sizes and shapes.

The HEPA filter medium is 100% moisture resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet or exceed Military Specification MIL-F-51079.

10.3.3 UO_2 Building (North) HVAC Systems

The UO_2 Building (north) has four air supply systems and four exhaust systems. The supply air systems consist of the following:

- The K1 HVAC system supplies air to the service areas of the building with a portion of this area being recirculated;
- The K2 HVAC system supplies air to the fabrication areas of the building with a portion of this air being recirculated and a portion being exhausted;
- The K23 HVAC system is a "once-through" HVAC system which supplies the uranium scrap and lube-blend areas; and
- The K36 HVAC system is also a "once-through" HVAC system which supplies the UF_6-UO_2 Line 2 conversion areas.

The exhaust air systems consist of the following:

- The K3 building exhaust system provides room and process hood exhaust for portions of the service areas and fabrication areas which are not recirculated air;
- The K9 system exhausts air from the etch room and etch tanks;
- The K10 is a process-off-gas (POG) system which serves process equipment in the Line 1 conversion and the uranium scrap reprocessing areas; and

- The K31 exhaust system, which is described in and primarily serves Line 2 conversion, also serves as the non-off-gas exhaust for the UF_6-UO_2 conversion, lube blend, and uranium scrap reprocessing areas.

All final filter banks in the four exhaust systems are tested and assured to have an installed efficiency of 99.95% for 0.8 micron particles. Simplified schematics of these HVAC systems are furnished in Figures II-10.21 and II-10.22.

10.3.3.1 K1 and K2 HVAC Air Supply Systems

The K1 HVAC system, which supplies air to the service areas of the building, and the K2 HVAC system, which supplies air to the fabrication areas, both use partial recirculation. Recirculated air in the K1 system is only rough filtered; recirculated air in the K2 system is passed through two stages of HEPA filters, the second of has an installed efficiency of 99.95% for 0.8 micron particles.

Provision is made in the K2 recirculation system for continuous radiation monitoring of recirculated air prior to the second filter. An indication of an airborne concentration exceeding eight MPC-hours automatically places the K2 system on a once-through basis with the air exhausting through the final filter and to the stack.

The K1 supply system provides about 28,600 ft^3/min of air which is divided between various laboratories, offices, change rooms, HVAC equipment room and production service areas. Approximately one-third of the system's air is recirculated within the K1 system, primarily from the second floor office areas, HVAC equipment room and building lobby.

The K2 supply system provides about 45,000 ft^3/min of air to the pellet preparation and pellet storage areas, autoclave area, and the etch facility. About 8,000 ft^3/min of the air in the K2 system is recirculated within the system from locations where radioactive contamination is expected to be zero or very low such as the autoclave area, supply room, production offices, and gauge and scale calibration rooms. In addition, another 4,000 ft^3/min of air from clean service areas supplied by the K1 system is recirculated through the K2 system.

In most of the process areas, the airflow is directional. Supply air is introduced from diffusers in the upper part of the room, and exhaust is taken into filter boxes near the floor around the periphery of the room.

10.3.3.2 K23 and K36 HVAC Air Supply Systems

The K23 HVAC system supplies approximately 12,000 ft^3/min of 100% outside air to the lube-blend and uranium scrap reprocessing areas, while the K36 HVAC system supplies approximately 12,000 ft^3/min of 100% outside air to the UF_6-UO_2 Line I conversion area. Airflows are directional from ceiling to near floor exhaust air grills or process hood inlets, and always from areas of low contamination potential to areas of higher contamination potential.

10.3.3.3 K3 Exhaust System

The majority of the building air (approximately 44,000 ft^3/min) is exhausted through the K3 system. The double filter arrangement in this system consists of the final filter bank, and individual or smaller filter banks of prefilters and HEPA filters in the exhaust ducts of the areas or equipment serviced.

The K3 system exhaust air passes directly from the final filter bank and is discharged from a stack extending 22 feet above the highest portion of the UO_2 Building, or 50 feet aboveground elevation. The K3 exhaust system has two full-capacity fans which are used alternately to provide standby capability. Both fans are connected to normal and emergency power.

10.3.3.4 K9 Exhaust System

The K9 exhaust system provides exhaust service for the corrosive fumes from the fuel rod etch and stop bath tanks. The exhaust is passed through a scrubber, dryer and double HEPA filters, and is discharged through a fiberglas-polyester stack 37 feet high. The ductwork material in the K9 exhaust system is steel, coated inside with acid resistant vinyl resin, upstream of the scrubbers and stainless steel main ducts and PVC branch ducts downstream.

The K9 exhaust system has two full-capacity fans which are used alternately to provide standby capability; both fans are connected to normal and emergency power. The K9 system exhausts approximately 6,000 ft^3/min continuously.

10.3.3.5 K10 Exhaust System

The K10 exhaust system provides approximately 1,200 ft^3/min vent service for tanks and vessels in the UF_6 process, as well as off-gas exhaust for the calciner, UF_6 vaporizer room and vaporizer chests. As in the etch process, fumes from these vessels are corrosive. The exhaust is passed through a scrubber, a dryer, and double HEPA filters (in series), and is discharged through a separate stack located on the roof of the UO_2 Building. This stack extends 25 feet above the highest portion of the UO_2 Building.

The ductwork material in the K10 exhaust system is stainless steel for ducts greater than seven inches in diameter, and polyvinyl chloride for ducts less than seven inches in diameter.

The single K10 exhaust fan is connected to emergency power, and should the fan become inoperative for any reason (including loss of power), or the system pressure decay to a predetermined set point, the UF_6 process will shutdown automatically. Air from the general UF_6 area will continue to be filtered and exhausted through the K31 system.

The scrubber is provided to remove ammonia and fluorides from the off-gases, the dryer to remove entrained liquids, and the filters to remove potential uranium. In addition to the main scrubber in the K10 system, there is a second scrubber in the exhaust line from the calciner.

10.3.3.6 System Controls

The HVAC systems are rather elaborately controlled with temperature, pressure, and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. In the event of power failure, K3, K9 and K31 exhaust fans are automatically transferred to an emergency electrical bus.

The power to the supply fans is interlocked so that exhaust fan failure, or failure of instrument or control air, stops the K1 or K2 supply fans. A similar upset in the K31 exhaust system will stop the K23 and K36 supply fans. In the event of power failure, the supply fans will stop and air will windmill through the supply fans due to the continuance of the exhaust fans on emergency power. A rise in exhaust pressure in the K10 system higher than -4 inches water gauge automatically shuts down the UF_6 process.

The differential pressure between the zone containing the building's lobby, stairwell, and change rooms on the first floor, and the offices and lunchroom on the second floor, and the zone comprising the rest of the building, will be maintained at a minimum of 0.05 inches water gauge with the former being at atmospheric pressure or slightly above, and the latter below atmospheric pressure at all times.

All main duct filters (K3, K9 and K10 systems) are provided with differential pressure indicators. Sudden changes in differential pressures across the final K3 filter bank or the K9 filter bank indicating either a filter rupture or excessive plugging, automatically (except the K10 exhaust fan) activate alarms.

10.3.3.7 Deluge System

A deluge system of fog spray nozzles is installed in the main exhaust (K3) duct a short distance upstream of the final filter bank. If heat detectors indicate a predetermined temperature rise, the deluge spray is automatically activated. Should the deluge system be activated by any circumstance, differential pressure readings across the filter will be taken and an in-place DOP/DOS test made at the earliest opportunity. The K9 and K10 systems have liquid scrubbers in-line and and ahead of the filters; therefore, they are not equipped with deluge systems.

10.3.3.8 Final Filter Banks

The final filter bank for the K3 system is encased in a sheet metal housing that, in turn, is fastened and sealed to a concrete slab. HEPA filters rated at 1000 ft^3/min at one-inch H_2O pressure drop are mounted on special American Air Filter clean room frames. The HEPA filter medium is 100% moisture resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet or exceed Military Specification MIL-F-51079.

Following the scrubber, the exhaust air of the K9 system enters a filter plenum which houses both the primary and final filters (two banks of HEPA filters in series). All construction features of the final filter bank of the K9 system are the same as for the K3 system.

The K10 system filters are single filters in series and are housed in separate housings. In the K10 exhaust system, there are two separate but identical legs. Each leg contains a scrubber, followed by a dryer, and the two HEPA filters in series. After the second filter in each leg, the legs are joined together in a common 12-inch duct which penetrates the roof of the building to the fan and stack. The K10 filters are mounted on steel frames instead of concrete slabs; all other construction features are the same as for the other systems.

10.3.4 UO_2 Building (South Addition) HVAC Systems

Although this building addition is physically attached to the original UO_2 Building, it has its own separate HVAC system (K20 supply, K21 exhaust, and controls). An airlock connecting the two facilities maintains separation of the two HVAC systems. A simplified schematic diagram of the HVAC system for this addition to the UO_2 Building is provided in Figure II-10.23.

10.3.4.1 K20 Supply Air System

There is one HVAC air supply system (K20) which serves all areas of this building. The K20 system also provides a small amount of air to the tube cleaning room which is a small structure physically attached to the UO_2 Building (south). The tube cleaning room (no contamination potential) has its own recirculation HVAC system and receives approximately 1000 ft^3/min from K20 for a nonprocess exhaust fan. Approximately 50% of the supply air is recirculated during normal operations. The design is such that air is moved from clean areas to areas of contamination potential. As such, return air from the office areas, HVAC equipment room, bundle assembly, cage inspection, and spacer fabrication areas is mixed with incoming air, rough filtered, and distributed throughout the building.

The K20 supply system provides approximately 46,000 ft^3/min of air which is divided between various areas within the building addition. About 9,000 ft^3/min of the supply air serves the office area, HVAC equipment room and tube cleaning facility, while 20,000 ft^3/min serves the clean fabrication, assembly/shipping areas on the west half of the building; all of which is redistributed (after rough filtering and mixing with incoming air) to other areas within the building. Approximately 17,000 ft^3/min of supply air is provided for the rod fabrication/loading/welding areas and discharged through the HEPA filtered K21 building exhaust system.

Airflow is directional in all production areas. Supply air is introduced from diffusers in the upper part of the room, and exhaust air is removed via process equipment enclosures or grills located near the floor around the periphery of the rooms.

10.3.4.2 K21 Exhaust System

The HVAC system has one exhaust system (K21) which serves the entire building addition. This exhaust system provides double HEPA filtration with the first stages of filtration located near process equipment enclosures or the individual exhaust grills in the various areas and the final stage in a common main exhaust filter bank. The final filter bank is tested, in-place, and assured to be 99.95% (minimum) efficient for removal of 0.8 micron size particles cold generated DOP/DOS aerosol.

The K21 system exhaust air is discharged from a stack extending 22 feet above the highest portion of the building, or 50 feet aboveground elevation. The K21 exhaust system has a primary full capacity exhaust fan and an alternate to provide backup capability. Both fans are connected only to normal power.

10.3.4.3 Systems Controls

The HVAC systems are rather elaborately controlled with temperature, pressure, and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The building ventilation systems are interlocked so that one of the K21 exhaust fans must be operating before the K20 supply fan can be started.

Duct airflow monitoring devices have been installed in the main exhaust duct, as well as in major supply and exhaust ducts to assist in measuring airflow (ft^3/min) for maintaining prescribed air change rates in process areas and calibrating representative duct air samplers.

The bundle assembly and cage fabrication areas are maintained essentially at atmospheric pressure, or slightly negative. The rod loading/fabrication area is maintained at a minimum of -0.05 inches water gauge in respect to the bundle assembly area, and +0.02 to 0.05 inches water gauge with respect to the north UO_2 Building pellet preparation area which is maintained at approximately -0.10 inches with respect to atmosphere. As long as the supply fan (K20) and exhaust fan (K21) plena pressures are maintained within indicated ranges, the building pressure differentials will be maintained. A differential pressure switch is provided across the main K21 exhaust HEPA filter bank to activate alarms on excessive filter buildup or plugging.

10.3.4.4 Deluge System

A fog deluge spray nozzle is installed in the main exhaust (K21) duct a short distance upstream of the final HEPA filter bank. If heat detectors indicate a predetermined temperature rise, the deluge spray and alarms are automatically activated. A steel spark arrester screen is provided between the deluge nozzle and final filter bank. Should the deluge system be activated by any circumstance, differential pressure readings across the filter will be taken and an in-place DOP/DOS test made at the earliest opportunity.

10.3.4.5 Final HEPA Filter Bank

The final HEPA filter bank for the K21 system is encased in a sheet metal housing that, in turn, is fastened and sealed to a concrete slab. HEPA filters rated at 1,000 ft^3/min at one-inch H_2O pressure drop are mounted in welded steel structural frames.

The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles, and meet or exceed Military Specification MIL-F-51079.

10.3.5 UO_2 Building Line 2 Conversion HVAC Systems

The general features of the UO_2 Building line 2 conversion HVAC systems are "once-through" ceiling-to-floor airflow supply air (K30) system, a two-stage HEPA filtered (K31) building exhaust system, and a process off-gas (K32) exhaust system with scrubbers, dryers, and two-stage HEPA filters.

A simplified schematic of the K30 air supply system, K31 building exhaust system, and K32 process off-gas (POG) system as shown in Figure II-10.22.

10.3.5.1 K30 Air Supply System

The K30 air supply system supplies approximately 28,000 ft^3/min of 100% outside air to the line 2 conversion area, UNH facility, vaporization room, control room, and the facilities equipment room. Airflows are directional from ceiling to near floor exhaust air grills or process hood inlets, and always away from areas of low contamination potential to areas of higher contamination potential.

10.3.5.2 K31 Air Exhaust System

The K31 air exhaust system removes approximately 28,000 ft^3/min of air supplied from the process areas served by the K30 air supply system, and 20,000 ft^3/min from areas supplied by the K23 and K36 (Figure II-10.22 and Section 10.3.3) air supply systems. The combined airflow, including infiltration, totals about 50,000 ft^3/min being exhausted through the K31 system. The double filter arrangement in this system consists of the final HEPA filter bank and individual or smaller filter banks of prefilters and HEPA filters in the exhaust ducts of the areas or equipment serviced. Ductwork in the K31 system is made of galvanized steel.

The K31 system exhaust air passes directly from the final filter bank to the exhaust fans, and is discharged from a stack extending 22 feet above the highest portion of the UO_2 Building, or 50 feet aboveground elevation. The K31 exhaust system has two full-capacity fans which are used alternately to provide standby capability. Both fans are connected to normal and emergency power.

10.3.5.3 K32 Exhaust System

The K32 exhaust system provides approximately 1,000 ft^3/min vent service for equipment, tanks and vessels in the UF_6 and dry conversion processes as well as off-gas exhaust for the calciner and exhaust service for the UF_6 vaporizer chests. As in the etch process, fumes from these vessels are corrosive and an exhaust system separate from the main K31 system is required. The exhaust is passed through a scrubber, a dryer, and double

HEPA filters in series, and is discharged through a separate stack located on the roof of the UO_2 Building. This stack extends 25 feet above the highest portion of the UO_2 Building. The ductwork material in the K32 exhaust system is stainless steel for ducts greater than seven inches in diameter, and polyvinyl chloride for ducts less than seven inches in diameter.

The K32 has two full-capacity fans which are used alternately to provide standby capability; both fans are connected to normal and emergency power. The scrubber is provided to remove ammonia and fluorides from the off-gases, the dryer to remove entrained liquids, and the HEPA filters to remove potential uranium. In addition to the main scrubber in the K32 system, there is a second scrubber in the exhaust line from the calciner.

10.3.5.4 System Controls

The HVAC systems are rather elaborately controlled with temperature, pressure, and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas.

The K31 exhaust fan power is interlocked so that the fans are stopped upon excessive negative pressure (more negative than -14 inches water gauge) and instrument or control air failure. In the event of power failure, the K31 fans are automatically transferred to an emergency electrical bus.

The power to the supply fans is interlocked so that a rise in K31 exhaust pressure higher than -8 inches water gauge (exhaust fan failure), or failure of instrument or control air, stops the K30 supply fan. A similar upset in the K31 exhaust system will stop the K23 and K36 supply fans. In the event of power failure, the supply fans will stop and air will windmill through the supply fans due to the continuance of the exhaust fans on emergency power. A rise in exhaust pressure in the K32 system (fan failure) higher than -4 inches water gauge automatically shuts down the UF_6 process.

The differential pressure between the conversion area zone and the zone comprising the rest of the UO_2 (north) Building will be maintained at a minimum of 0.05 inch water gauge, and a minimum of -0.05 inch water gauge below atmospheric pressure at all times.

As long as the supply and exhaust plena pressures remain in the indicated ranges, building pressure differentials will be maintained. Sudden changes in differential pressure across the final K31 filter bank or the K32 filters indicating a filter plugging, automatically activates alarms.

10.3.5.5 Deluge System

A deluge system of fog spray nozzles is installed in the main K31 exhaust duct upstream of the final filter bank. If heat detectors indicate a predetermined temperature rise, the deluge spray is automatically activated. Should the deluge system be activated by any circumstance, differential pressure readings across the filter will be taken and an in-place DOP/DOS test made at the earliest opportunity. The K32 system has liquid scrubbers in line ahead of the filters; therefore, it is not equipped with a deluge system.

10.3.5.6 Final HEPA Filter Bank

The final HEPA filter bank for the K31 system is encased in a poured and sealed concrete structure. HEPA filters rated at 1,000 ft^3/min at one-inch H_2O pressure drop are mounted in welded steel structural frames. Visual indicators for reading the pressure drop across the filters are permanently installed and means are provided for in-place DOP/DOS testing.

The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet or exceed Military Specification MIL-F-51079.

10.3.6 U_3O_8 Facility HVAC Systems

The U_3O_8 facility and the tank canyon area are served by two individual (K38 and K39) air supply systems but share a common two-stage HEPA filtered (K37) exhaust system, except for the tank canyon area which is single stage HEPA filtered. A simplified schematic of the K38 and K39 air supply systems and the K37 building exhaust system is shown in Figure II-10.24.

10.3.6.1 K38 Air Supply System

The K38 air supply system provides about 4,900 ft^3/min of 100% outside air to the tank canyon area and the ion exchange room. Airflows are directional from ceiling to near floor exhaust air grills or process hood inlets, and always away from areas of low contamination potential to areas of higher contamination potential.

10.3.6.2 K39 Air Supply System

The K39 air supply system provides about 9,000 ft^3/min of 100% outside air to the U_3O_8 receiving and processing areas, a hot maintenance shop, the powder storage area, and an airlock. Airflows are directional from ceiling to near floor exhaust air grills or process hood inlets, and always away from areas of low contamination potential to areas of higher contamination potential.

10.3.6.3 K37 Air Exhaust System

The K37 air exhaust system removes approximately 5,500 ft^3/min of air supplied from the process area served by the K38 air supply system, and 9,000 ft^3/min of air supplied by the K39 HVAC system. This combined airflow, including infiltration, totals about 15,500 ft^3/min being exhausted through the K37 system. The double filter arrangement in this system consists of the final HEPA filter bank and individual or smaller filter banks of prefilters and HEPA filters in the exhaust ducts of the areas or equipment serviced. Room exhaust air from the tank canyon area is rough-filtered locally and mixed with K37 exhaust air from other areas which is passed through the K37 final HEPA filter bank. Ductwork in the K37 system is made of galvanized steel.

The K37 system exhaust air passes directly from the final filter bank to the exhaust fan, and is discharged from a stack extending 24 feet above the highest portion of the UO_2 Building, or 50 feet aboveground elevation. The K37 exhaust system has one full capacity fan which is connected to normal power. All final HEPA filters are in-place tested and assured to be 99.95% minimum efficient for 0.8 micron DOP/DOS cold aerosol.

10.3.6.4 System Controls

The HVAC systems are rather elaborately controlled with temperature, pressure and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The building ventilation systems are interlocked so that the K37 exhaust fan must be started before the supply systems can be started.

The K37 exhaust fan power is interlocked so that the fans are stopped upon excessive negative pressure (more negative than -12 inches water gauge) and instrument or control air failure. The power to the supply fans is interlocked so that a rise in K37 exhaust pressure higher than -4 inches water gauge (exhaust fan failure), or failure of instruments or control air, stops the supply fans.

The differential pressure between the hot maintenance shop zone and the zone comprising the rest of the U_3O_8 Building will be maintained at a minimum of 0.05 inch water gauge, and a minimum of -0.05 inch water gauge below atmospheric pressure at all times. The tank canyon and ion exchange area will be maintained at a minimum of -0.05 inch water gauge below atmospheric pressure at all times. As long as the supply and exhaust plena pressures remain in the indicated ranges, building pressure differentials will be maintained.

10.3.6.5 Deluge System

A deluge system of fog spray nozzles is installed in the main K37 exhaust duct a short distance upstream of the final filter bank. If heat detectors indicate a predetermined temperature rise, the deluge spray is automatically activated. Should the deluge system be activated by any circumstance, differential pressure readings across the filter will be taken and an in-place DOP/DOS test made at the earliest opportunity.

10.3.6.6 Final HEPA Filter Bank

The final HEPA filter bank for the K37 system is encased in a sheet metal housing that, in turn, is fastened and sealed to a concrete slab. HEPA filters rated at 1,000 ft^3/min at one-inch H_2O pressure drop are mounted in welded steel structural frames.

The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet or exceed Militiary Specification MIL-F-51079.

10.3.7 ELO Building HVAC Systems

The ELO Building has two independent HVAC systems. The north side of the building is basically an office/service area recirculating type (K26) HVAC system with an unfiltered exhaust. The south half of the building is a research and development area with combination "once-through" and recirculation supply (K24) and a two-stage HEPA filtered (K25) exhaust system. The north and south sides of the building are isolated with a structural wall and access to the south side is gained via an airlock. A simplified schematic diagram of these HVAC systems is shown in Figure II-10.25.

10.3.7.1 K26 Air Supply System

The K26 air supply system provides about 5,000 ft^3/min of air to the office/service area (north half) of the ELO Building, and 1,400 ft^3/min to the office portion of the adjacent ELO addition. Except for about 800 ft^3/min make up air; the K26 unit is a recirculating HVAC system. The K26 HVAC system is activated with a simple ON/OFF switch, operates at atmospheric pressure, and has no electrical control interties with the south portion of the building.

10.3.7.2 K24 Air Supply System

The K24 air supply system provides about 10,000 ft^3/min of air to the south half of the ELO Building. The ground floor area consists of a mezzanine utility area and dark room; the basement includes a machine shop, test

development area, and a development laboratory. Approximately 7,000 ft^3/min of air from the mezzanine, machine shop, and test development area are recirculated through a single stage HEPA filter bank and returned back to the building. Air supplied to the development laboratory is exhausted through two stages of HEPA filters.

Recirculated air is passed through a roughing filter and a single stage of HEPA filtration with an installed efficiency of 99.95% for 0.8 micron DOP/DOS cold generated aerosol. Provision is made in the K24 recirculation system for continuous alpha radiation monitoring of recirculated air upstream of the HEPA filter bank. The alpha air monitor is set to alarm and annunciate when alpha activity exceeds eight MPC-hours.

10.3.7.3 K25 Air Exhaust System

The K25 exhaust system provides about 2,500 ft^3/min of exhaust air from the development laboratory, and 500 ft^3/min of air form the test development areas for a total of about 3,000 ft^3/min. The double HEPA filter arrangement in this system consists of a final HEPA filter bank and individual prefilters and HEPA filters in the exhaust ducts of the areas or equipment serviced. Ductwork in the K25 system is made of galvanized steel.

The K25 system exhaust air passes directly from the final filter bank to the exhaust fan, and is discharged from a stack extending eight feet above the building, or 20 feet aboveground elevation. The K25 system has a single full-capacity exhaust fan connected to normal power.

10.3.7.4 System Controls

The HVAC systems are rather elaborately controlled with temperature, pressure and flow sensors actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The building ventilation systems are interlocked so that the K25 exhaust fan must be operating before the K24 supply fan can be started. Pressure sensors are provided for valve and damper control to maintain the development laboratory negative pressures at -0.10 inches water gauge. The K25 exhaust fan power is interlocked so that the fan is stopped upon loss of negative pressure (less negative than -8 inches water gauge), instrument or control air failure, radiation or heat detection or loss of differential pressure across supply fan K24.

The power to the K24 supply fan is interlocked so that a loss of exhaust duct negative pressure (less than -8 inches water gauge), loss of K24 supply fan differential pressure, radiation or heat detection in recirculation or exhaust ductwork, or loss of instrument or control air, stops the supply fan.

The mezzanine, machine shop, and test development areas are maintained at -0.05 inches water gauge in respect to atmosphere and the north half of the building. The development laboratory is maintained at between -0.05 and -0.10 inches water gauge in respect to atmosphere and negative to the adjacent machine shop area at all times. As long as the supply fan (K24) and exhaust fan (K25) plena pressures are maintained within indicated ranges, the building pressure differentials will be maintained.

10.3.7.5 Final HEPA Filter Bank

The final HEPA filter bank for the K25 system is a sheet metal frame and housing that is fastened to a concrete slab. HEPA filters rated at 1,000 ft^3/min at one-inch H_2O pressure drop are mounted in steel frames. Visual indicators for reading the pressure drop across the filters are permanently installed and means are provided for in-place DOP/DOS testing.

The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet or exceed Military Specification MIL-F-51079.

10.3.8 ELO Addition HVAC Systems

Although this building addition is physically attached to the original ELO Building, it has its own separate HVAC systems (K45 (supply) and K46 (exhaust). The building is physically divided with the north portion serving as an office area, and the south portion housing engineering test operations, an instrument laboratory, several metallography laboratories, and various chemical laboratories. The north office portion of the building is served by the original ELO Building office (K26) HVAC system (see Figure II-10.25), and is separated from the laboratory portion by a series of airlocks. The south portion of the building is served by the K45 air supply and K46 air exhaust HVAC systems.

The general features of the ELO Building addition HVAC systems are a "once-through" ceiling-to-floor airflow supply air (K45) system, and a two-stage HEPA filtered (K46) building exhaust system. A simplified schematic of the K45 air supply system and K46 building exhaust system is shown in Figure II-10.26.

10.3.8.1 K45 Air Supply System

The K45 air supply system provides about 16,000 ft^3/min of 100% outside air to the south portion of the ELO addition. Airflows are directional from ceiling to near floor exhaust air grills or process hood inlets, and always away from areas of low contamination potential to areas of higher contamination potential.

10.3.8.2 K46 Air Exhaust System

The K46 air exhaust system removes approximately 18,000 ft^3/min of air supplied from the process areas served by the K45 air supply system. The double filter arrangement in this system consists of the final HEPA filter bank and individual or smaller filter banks or prefilters and HEPA filters in the exhaust ducts of the areas or equipment serviced. Ductwork in the K46 system is made of galvanized steel.

The K46 system exhaust air passes directly from the final filter bank to the exhaust fans, and is discharged from a stack extending 23 feet above the main portion of the UO_2 Building, or 35 feet aboveground elevation. The K46 exhaust system has a single full-capacity fan connected to normal power.

10.3.8.3 Systems Controls

The HVAC systems are elaborately controlled with temperature, pressure and flow sensor actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The K45 supply air system is interlocked with the K46 exhaust system to prevent operation of the K45 supply air system without the K46 exhaust system operating. Pressure sensors are provided for damper control to maintain a negative pressure (minimum -0.05 inches water gauge) in the laboratory areas relative to the office area and to atmosphere, and to maintain an exhaust duct negative pressure between -4 inches and -12 inches water gauge. Any loss of instrument air prevents the supply and exhaust systems from operating. Both the K45 supply fan and K46 exhaust fans are interlocked so that a loss of exhaust duct negative pressure above -4 inches water gauge (toward zero) will shutdown the supply fan, or an increase of exhaust duct negative pressure below -12 inches water gauge will shutdown the K45 supply air system and the K46 exhaust air systems.

Automatic audio and visual alarms are activated when any supply or exhaust system upset occur. Pressure differential indicating devices and airflow quantity meters are located in the controlled zones and/or on the main HVAC panel to provide system and zone operating conditions.

10.3.8.4 Deluge System

A deluge system of fog spray nozzles is installed in the exhaust duct a short distance upstream of the final filter banks. If heat detectors indicate a temperature of 140-190°F, the deluge spray is automatically activated. Should the deluge system be activated by any circumstance, differential pressure readings across the final filters will be taken and an in-place DOP/DOS test made at the earliest opportunity.

10.3.8.5 Final Filter Bank

The final filter bank is encased in a poured and sealed concrete structure. HEPA filters rated at 1,000 ft^3/min at one-inch H_2O pressure drop are mounted in welded, steel structural frames. The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet, or exceed, Military Specification MIL-F-51079.

10.3.9 Contaminated Clothing Laundry HVAC System

The general features of the contaminated clothing laundry HVAC system are a "once-through" ceiling-to-floor airflow supply system, and a single stage HEPA filtered exhaust system. A simplified schematic diagram of the K41 air supply system and the K42 air exhaust system is shown in Figure II-10.27.

10.3.9.1 K41 Air Supply System

The K41 air supply system supplies about 1,900 ft^3/min of 100% outside air to the cleaning room and adjoining sorting room. Airflows are directional from ceiling to near floor exhaust air grills or hood inlets and always away from areas of low contamination potential to areas of higher contamination potential.

10.3.9.2 K42 Air Exhaust System

Air supplied to the cleaning and sorting rooms, plus infiltration (approximately 2,100 ft^3/min), is exhausted through the K42 exhaust system. The single HEPA filter arrangement in this system consists of the final HEPA filter bank and individual prefilters located in the exhaust ducts of the two rooms serviced.

The K42 system exhaust air passes from the final filter bank through a duct air monitor (measures airflow quantities), the main exhaust fan, and is discharged from a stack extending 25 feet aboveground on the southwest side of the building. The K42 exhaust system has one full capacity fan which is connected to normal power. All final HEPA filters are in-place tested and assured to be 99.95% (minimum) efficient for 0.8 micron DOP/DOS cold aerosol.

10.3.9.3 Systems Control

The HVAC systems are elaborately controlled with temperature, pressure and flow sensor actuating valving and damper positions to hold temperature, pressures, and pressure differentials constant in the various building areas. The K41 supply air system is interlocked with the K42 exhaust system to prevent

operation of the K41 supply air system without the K42 exhaust system operating. Pressure sensors are provided to maintain a minimum negative differential pressure of 0.05 inches water gauge in the cleaning room relative to the sorting room. The sorting room is maintained at approximately -0.02 to -0.05 inches water gauge in respect to atmosphere.

The supply fan (K41) is interlocked so that a loss of exhaust duct negative pressure above -3 inches water gauge (exhaust fan failure) or a signal from the exhaust duct heat detector will shutdown the K41 air supply system.

Automatic visual alarms are activated when any supply or exhaust system upset occurs. Pressure differential indicating devices and airflow quantity meters are located on the main HVAC panel to provide system and zone operating conditions.

10.3.9.4 HEPA Filter Bank

The final HEPA filters are enclosed in a sheet metal housing that, in turn, is mounted on structural steel legs fastened to a concrete slab. The HEPA filters are rated at 1,000 ft^3/min at one-inch H_2O pressure drop, and are mounted in welded, steel frames. Continuous air samplers are installed downstream of the filter bank. Visual indicators for reading the pressure drop across the filters are permanently installed, and means are provided for in-place DOP/DOS testing.

The HEPA filter medium is 100% moisture-resistant fiberglas, pleated over corrugated separators, and sealed in fire-resistant plywood frames. The individual filters are certified to remove 99.97% of 0.3 micron particles and meet, or exceed Military Specification MIL-F-51079.

10.4 Radioactive Waste Handling

The facilities and processes which are involved in handling of radioactive and chemical wastes produced by the Exxon Nuclear Fuels Facility at Richland are described in the following sections.

10.4.1 Lagoon System Description

The lagoons provide containment for all uranium and chemically contaminated liquid wastes generated at the Horn Rapids site. Natural evaporation, controlled waste addition, waste discharge to the municipal sewer, and water additions are used to control the volume of liquid stored in the lagoons. Interlagoon transfers are periodically made for both uranium accountability and volume control purposes. Sampling between lagoon liners is conducted monthly to determine if leaks have occurred in the liners.

There are six liquid waste storage lagoons, one solids leach pit, and one sand storage pit located along the east boundary of the Horn Rapids site (see Figure II-10.1). The sand pit is located immediately west of lagoon 3. The solids leach pit is located immediately west of lagoon 2. The dimension and capacities of the lagoons are:

Lagoon	Dimensions	Estimated Capacity 10^6 Gallons
1	240' x 200' x 3' deep	1.4
2	240' x 100' x 3' deep	0.7
3	240' x 350' x 5'-6" deep	3.5
4	240' x 290' x 6' deep	2.7
5A	240' x 175' x 7'-6" deep	1.6
5B	240' x 175' x 7'-6" deep	1.6
Leach Pit	40' x 54' x 8'-6" deep	0.06
Sand Pit	39' x 300' x 6' deep	0.3

The lagoons and the solids leach pit have a "sandwich" construction; they each have two liners made of Hypalon material, separated by six inches of sand. On lagoons 1, 2 and 3, the "sandwich" rests on an asphalt-type surface known as Petromat. In the sand layer between the Hypalon liners are an array of sample heads. The sand storage pit is single lined, and therefore does not have between-liner sampling capabilities. Tubing from each of the heads is routed to the berms on both the east and west side of the lagoons where small pumps can be periodically connected. Some additional sampler heads are located between the original Petromat liner and the lower Hypalon liner. Lagoon 4 is equipped with three "dry wells" below the bottom Hypalon liner. Samplers are located in each dry well. All sampler heads are pumped each month for leak detection purposes using small air-driven pumps.

Lagoon 1 is used as a receiver of ammonia-bearing solutions from the conversion area with a low level of uranium and is the feed lagoon for the ammonia recovery process. It has a Hypalon floating cover over it to contain the ammonia fumes.

Lagoon 2 is used as an accountability lagoon for high uranium-bearing solutions.

Lagoon 3 is a storage lagoon for high uranium wastes and serves as the feed lagoon to the Lagoon Uranium Recovery facility (LUR).

Lagoon 4 is a storage lagoon for low uranium content waste from the LUR process. Lagoon 4 also serves as the feed lagoon for LUR waste to the Ammonia Recovery facility (AR).

Lagoon 5A is a storage lagoon for waste streams from the AR facility and miscellaneous low uranium, low ammonia chemical wastes. Disposal of waste from lagoon 5A to the sewer is accomplished after verification of e waste uranium and chemical content. The waste sewering rate is automatically controlled by a microprocessor via a flow measuring and control system. The sewered chemical waste is volume proportionally sampled. The chemical waste sewering rate is controlled, based on waste composition, so as to remain within discard limits.

Lagoon 5B is currently used to store high uranium waste which will be treated for uranium recovery. Once emptied, this lagoon will be used as a batching lagoon in conjunction with lagoon 5A to receive AR facility waste for metered discharge to the City sewer.

The solids leach pit is used for development of a process to recover uranium from the lagoon solids and the sand storage pit solids.

The sand pit is used as a storage pit or trench for sand and sludge that has been removed from the liquid storage lagoons during clean up over the years of operation.

Periodically, liquid waste solutions are transferred from one lagoon to another for accountability, volume control or maintenance purposes. A permanently mounted pump with interconnecting piping is provided which enables solution to be pumped from any lagoon to any other lagoon, and also allows recirculation within any lagoon.

10.4.2 Ammonia Recovery Description

The ammonia recovery process is housed in a 960 square foot insulated steel structure located north of lagoon 1 (see Figure II-10.1). The structure is designed to withstand UBC Zone 2 seismic loading, and 20 lb/ft^2 windward pressure. An equipment arrangement is shown on Figure II-10.28. The Engineering Flow Diagram is presented on Figure II-10.29. A brief description of the major equipment pieces is given in Table II-10.1.

The unneutralized low uranium content liquid process waste from lagoon 1 is transferred to the feed tank which provides a one-hour surge capacity to smooth out feed rate fluctuations. The feed tank also receives AR building sump wastes, recycle stripper bottoms, and ammonium hydroxide product for rework. The feed solution is pumped via a flow control system and a recovery heat exchanger to the ammonia stripper. The tank is maintained under a slight vacuum by venting through a scrubber. The Recovery Heat Exchanger is provided to reduce energy requirements for the process by using the hot stripper bottoms to preheat the feed solution.

The liquid waste from the feed tank is in-line blended with LUR waste from lagoon 4 (see Section 10.4.3) and with caustic (NaOH) and then routed to the stripping column. Excess caustic is added to the waste stream to result in a pH greater than 10 in the ammonia stripped waste stream which reduces the corrosion rate and allows the use of 300 series stainless steel for construction.

The ammonia stripping column provides for removal of ammonia from the waste solution by countercurrent contact with steam and is designed to produce 20 to 30 wt% ammonia product solution and waste effluent at less than 100 ppm ammonia. The bottoms from the stripper are pumped to the designated waste treatment batching lagoon (5A or 5B) or recycled back to the feed tank, depending on its ammonia concentration and pH.

The air purge system on the pneumatic instrument lines is designed to prevent backup of process fluids in the event of excessive system pressure. A 50 psig rupture disk is provided at the top of the column to prevent overpressurization of the system. The pressure relief vents to the atmosphere through the tower roof.

The condensables from the stripper overheads are removed in a downdraft condenser and are routed to the distillate tank. An automated deionized water injection system is provided to improve ammonia removal efficiency and to control the ammonia hydroxide concentration.

A scrubber is provided to remove ammonia from the process vessel off-gas. The scrubber bottoms are routed to the feed tank. The scrubbed off-gas is monitored for ammonia and vented to the atmosphere via the building exhaust fan and stack.

The control system is an electronic digital microprocessor system. The console can access any information and display it on the CRT. In case of transmitter failure, the processors will adjust to a safe value that can keep the process from going too far out of control. Deviations from set points are alarmed when they surpass their predetermined limits and the printer documents the event.

A steam boiler provides a maximum of 3000 lb/hr of 40 psig steam to the AR process. Local mounted pressure switches control the boiler operating pressure between 35 and 40 psig. Steam header pressure instrumentation is provided to shutdown the process and alarm on low and high steam pressure.

A 28,000 gallon aboveground sodium hydroxide storage tank is provided to supply the AR process. The tank is insulated and heated with a 5 kW heater to maintain the caustic temperature above 65°F. All exterior piping

is heat traced and insulated. A safety shower is provided at the load-in facilities. Operation of the NaOH storage system is monitored and controlled at the control room.

A 28,000 gallon aboveground storage tank is provided to store NH_4OH product from the AR process. Facilities are provided to load out excess ammonium hydroxide for sale off-site. The NH_4OH used for recycle to the process is transferred to either of two 10,000 gallon ammonium hydroxide storage tanks.

A concrete spill containment structure is provided for the outside bulk sodium hydroxide and product ammonium hydroxide storage tanks. The structure is designed to contain chemicals from a ruptured storage tank.

The building exhaust system consists of a two-speed fan, temperature controls, an ammonia monitor, and stack. The exhaust fan is normally run on low speed (approximately 1700 cfm). The fan is switched to high speed (approximately 5000 cfm) if the building exhaust temperature exceeds 110°F or, if the ammonia concentration is excessive. The building exhaust air ammonia monitoring system is set to alarm locally and in the Line 2 control room at 50 ppm ammonia. A high alarm automatically activates the exhaust fan high-speed operating mode and shuts the process down.

The AR facility fire detection and alarm system has been tied into the existing plant systems.

Criticality in the ammonia recovery system is not deemed credible due to the extremely low concentration of uranium. In addition, the feed tank and stripping column were designed for solids to flush through the system. Nevertheless, the system is inspected quarterly for signs of buildup of uranium solids. The plant criticality warning system also covers the AR facility.

10.4.3 Lagoon Uranium Recovery (LUR) Facility Description

The LUR facility is provided to recover low enriched uranium from stored high uranium content liquid chemical wastes (see Section 10.4.1). Following uranium recovery, the waste is treated for ammonia removal (see Section 10.4.2), then disposed to the municipal sewer.

The LUR facility is located adjacent to lagoon 4 as shown on Figure II-10.1. The equipment consists of six process vessels, one chemical makeup vessel, and associated pumps, piping, and filters. A brief description of the major equipment is given in Table II-10.2, and the equipment layout is depicted in Figure II-10.30. The equipment is not housed, but is partially covered. The process equipment is not freeze-protected and is, therefore, shutdown and winterized during cold weather.

A process flow diagram for the uranium recovery system is presented in Figure II-10.31. Approximately 4,000 to 6,000 gallons of high uranium content waste is pumped into the precipitator. The uranium is precipitated from solution by addition of a reductant and allowed to settle. At the end of the settling period, the supernatant is decanted to lagoon storage. This procedure is repeated until the total precipitate accumulated in the precipitator vessel reaches the desired batch size. The uranium precipitate is slurried to the washer tank and receives water washes for extraneous chemical removal. The washed precipitate is then slurried into a container, dissolved in aluminum nitrate solution, transferred to a plastic-lined 55 gallon drum and placed into storage. The recovered uranium is purified for reuse through existing solvent extraction facilities.

The basis for criticality control is mass control. The mass in any vessel is maintained at less than 45 percent of the minimum mass required for criticality. The typical mass in any vessel is usually less than 30 percent of the minimum critical mass. A minimum spacing of three feet is maintained between all process vessels.

10.4.4 Solids Uranium Recovery Facility

The lagoon solids uranium recovery facility consists of the solids leach pit and tank, the sand trench, and lagoons 2 and/or 3. Two 48-inch diameter Sweco vibrating screens are used to separate the solids into four fractions. The solids are pumped as a water slurry from the sand trench to the Swecos. None of these facilities are sheltered.

The slimes and fines in the sand trench and lagoon solids contain essentially all of the uranium. On a volume basis, the slimes and fines are about 20 percent of the solids volume and the remaining 80 percent is sand.

In order to facilitate the recovery of the uranium and the disposal of the solid wastes, the solids will be separated into five fractions. The separation into the five fractions is achieved by first screening the material to remove the >3/8 inch material. The undersize material is mixed with water and pumped to a 48-inch diameter Sweco for separation into >20 mesh, >150 mesh and <150 mesh fraction. A subsequent Sweco is used to separate the >80 and the >150 mesh materials and to increase the efficiency with respect to removal of material <150 mesh.

The water and the <150 mesh material bearing the uranium is discharged to lagoons 2 and/or 3 for temporary storage while emptying the sand trench. The >150 mesh fraction is collected in the solids pit for treatment to remove the last traces of uranium. The >80 mesh material is discarded or combined with the >150 mesh, depending on the uranium contamination. The >20 mesh material will be held in drums and/or the sand trench until all of the sand (>150 mesh) fraction is processed. The >20 mesh will be rewashed via the

Sweco unit and will then be treated in the same manner as the sand fraction discussed above. The >3/8 inch material will be washed with water in a small cement mixer in order to remove the sand and slimes. The large solids will be discarded. The water washes will be processed through the Sweco unit.

After the economic uranium values have been removed from the slimes and fines, the solids will be filtered, combined with drying and solidifying agents, and packaged for disposal. At this time, it is anticipated the system, which will be used for disposal of Solid Waste Uranium Recovery (SWUR) ash, can also be used for disposal of these solids.

10.4.5 Solid Waste Uranium Recovery Facility Description

The SWUR facility has been designed to incinerate uranium contaminated, combustible solid waste for volume reduction and uranium recovery. The incinerator and auxiliary systems are located in Room 173 of the Specialty Fuels Building (see Section 10.1.1).

The process is divided into five systems: Feed preparation, incineration, off-gas cleaning, and ash handling and ash leaching.

10.4.5.1 Feed Preparation

Solid wastes, generated in the nuclear fuel fabrication facilities, are sorted into combustible and noncombustible waste fractions. The noncombustible wastes are surveyed item-by-item for uranium content and are packaged for disposal at a licensed nuclear burial ground. The combustible wastes are packaged in 55-gallon plastic-lined metal drums for storage, or in plastic-lined cardboard boxes for feed to the incinerator. The combustible waste packages are weighed and assayed for uranium content prior to storage or incineration.

The incinerator feed packages are conveyed to the incinerator hydraulic ram feeder, which is automatically controlled to feed the incinerator primary chamber through a hydraulic guillotine door. The ram feeder has a sealed loading hopper and can handle up to one cubic yard feed batches. The guillotine door and ram feeder are interlocked to prevent simultaneous opening of both doors and the feed hopper and ram space are inerted using a nitrogen fire suppression system.

10.4.5.2 Incineration

The safe batch controlled incinerator has a nominal capacity of 200 lb/hr of uranium contaminated combustibles waste consisting of paper, plastics, wood, etc. The incinerator is a commercial controlled air unit modified to minimize ash holdup and to facilitate good carbon burnout and system cleanout. The unit consists of primary and secondary chambers, each constructed of a carbon steel shell, internally coated with a mastic material

for acid gas corrosion protection, and lined with both insulating and high density castable refractory selected to minimize permeation of uranium contamination.

Both chambers have propane-fueled burners and combustion air ports. The primary chamber is operated at 1600-1800°F and the combustion airflow is controlled to near stoichiometric requirements to promote quiescent burning with minimal particulate entrainment. Combustion products and pyrolysates are passed to the secondary chamber where excess air and high temperature (approximately 2000°F) and a minimum two second residence time combine to completely burn all combustible gases.

10.4.5.3 Off-Gas Treatment System

The incinerator exhaust gas from the afterburner chamber contains particulates, vapors and gases (including acid gases) which result from the combustion of cellulose, rubber, and plastics present in the waste feed. Cooling of the gases and removal of the acid gases and potentially radioactive particles is accomplished by components which consists of a quench column, a high energy venturi scrubber, a packed column, a mist eliminator, a reheater, and a HEPA filtration module.

The quench column is divided into an upper contacting section and a lower sump section. In the contacting section, cooling and saturation of the incinerator exhaust gas occurs simultaneously by the evaporation of scrub solution liquid. Excess solution collects in the 10-inch diameter sump section while the saturated gas is routed to the inlet of the venturi scrubber.

The variable throat, high energy venturi scrubber located between the quench column and the packed column removes more than 99 wt% of the off-gas particulates. Scrub solution is injected through a nozzle located upstream of the throat.

The packed column is designed to slightly cool the off-gas and to remove the acid gases from the gas phase by countercurrent contact with recycled scrub solution. The gas discharges from the packed column through a polypropylene mist eliminator.

The gas enters the electric reheater where it is warmed to a minimum of 15°C above the saturation temperature. This reduces the relative humidity of the gas to prevent wetting of HEPA filters. The reheater is controlled by an SCR controller which maintains the proper temperature difference from the reheater inlet to the filter outlet.

The off-gas module contains the prefilter and two banks of HEPA filters. The stainless steel module housing is designed and reinforced to withstand the -110 inch H_2O vacuum to which it may be exposed. DOP/DOS testing of the final HEPA filter bank can be accomplished.

Particulates that have been scrubbed from the gas stream are removed from the scrub solution by the filters. The filter elements are made from combustible materials so that once they are expended, they can be burned in the incinerator. Minimum expected replacement period between element changeout is eight hours.

The scrub solution liquid is circulated by redundant pumps to insure a continuous stream of scrub solution liquid. Automatic switchover of pumps occurs upon on-line pump failure.

Scrub solution liquid is cooled by a plate-type heat exchanger. Cooled liquid is used to improve acid gas absorption and to reduce the packed column discharge gas temperature. Caustic addition to the system is automatically controlled by the pH controller in the packed column scrub solution liquid line.

Scrub solution NaCl concentration is maintained at 6 percent in order to prevent corrosion of metal components. Other major chemical constituents of the scrub solution liquid will be Na_2CO_3 (from CO_2 absorption), Na_2SO_4 (from SO_2 neutralization), NaOH (caustic addition), and small amounts of NaF and $NaNO_3$ (from chemicals in the feed). A total dissolved solids analyzer, which basically works on solution conductivity, is provided to control the blowdown stream. The blowdown stream is proportionally sampled and discharged to lagoon 5A (see Section 10.4.1).

10.4.5.4 Ash Handling

Ash formed from the combustion of wastes is pushed along the hearth by incoming feed and by an internal ash plow. The ash is pushed through an ash gate into an ash pit located at the end of the hearth. The ash is cooled in an isolation chamber that discharges periodically into a drum.

The drummed ash is transported to an ash screening and milling area where oversize and/or metallic klinkers are separated. The oversize material is milled and combined with the ash in the drum. The drum is assayed for uranium content and stored and/or transported to the UO_2 Building ash dissolution-packaging area. Drums of ash, low in uranium content, are not leached.

10.4.5.5 Incinerator Ash Leaching

Combustion ash is leached with a sodium carbonate-sodium, bicarbonate-sodium, hypochlorite solution at elevated temperature in an agitated vessel that is operated on a batch basis for criticality control.

The leaching solution and solids are separated by a rotary drum filter. Following separation, the solids are mixed with drying and solidifying agents and loaded into containers for disposal. The leaching solution is treated with an acid at an elevated temperature and air sparged to destroy carbonates. After destruction of the carbonates, the solution is routed to the miscellaneous uranium recovery system for precipitation and recovery of the uranium.

10.5 Fire Protection

10.5.1 Building Codes and Standards

All permanent buildings at the fuel fabrication plant were constructed in accordance with the applicable sections of the following building codes and standards.

- Uniform Building Code (Seismic Zone 2)
- Uniform Plumbing Code
- Uniform Mechanical Code
- Uniform Fire Code
- National Fire Codes (NFPA)
- National Electrical Code ANSI-C1
- ASHRAE Standards
- Chapter 296-44 Washington Administrative Code
- Chapter 296-24 Washington Administrative Code
- Richland Municipal Code and Zoning Regulations
- Richland Municipal Ordinances Number:

  3777 (adopt. Building Code)
  3877 (adopt. Plumbing Code)
  3977 (adopt. Mechanical Code)

10.5.2 Fire Protection Liability Inspections

Exxon Nuclear Company, Inc. has elected to self-insure with regard to property damage. Exxon Corporate Headquarters schedules a fire protection audit of its affiliate subsidiaries approximately every three years by an acknowledged fire protection consultant. The City of Richland's Department of Fire and Emergency Services conducts annual fire protection inspections of Exxon Nuclear's fuel fabrication plant facilities.

The most recent copies of these audits and inspections, along with Exxon Nuclear's reply, are appended. (See Appendix A.)

10.5.3 Fire Protection Program

10.5.3.1 Combustible Solid Waste Handling and Storage

Outside metal waste containers are provided by the City of Richland for clean wastes. Contaminated combustible wastes are properly sorted into metal boxes or drums, sealed and stored on an outside pad for future uranium recovery or disposal per approved procedures. Additional contaminated combustible wastes are stored in a fire-resistant metal building near the waste barrel/box storage pad. Combustible wastes generated inside the process and other buildings (either clean or contaminated) are collected in metal waste containers and emptied daily into the appropriate waste storage containers.

10.5.3.2 Flammable Liquid Storage

Flammable liquids are stored in approved safety containers or cabinets near the final use location. Additional storage for flammable liquids is provided for in a fire-resistant metal warehouse located away from any radioactive material storage area.

10.5.3.3 Combustible Liquid Storage

Combustible liquids are stored in approved metal containers near the final use location. Additional storage for combustible liquids is provided for on an outside storage pad.

10.5.3.4 Fire Prevention

The manifolds for supplying combustible gases to the facility, including backup hydrogen for the sintering furnaces, are located outside the main building structure. All combustible gas distribution piping meets applicable NFPA codes.

Combustible gas burn-off devices and combustible gas detection equipment are used where necessary to prevent explosion and fires around sintering furnaces and ovens.

The HEPA exhaust filters in the UO_2 and SF Buildings are protected from high temperatures and burning debris in the event of fire by automatic deluge systems in the exhaust plenums immediately upstream of the final filter bank.

10.5.3.5 Fire Detection and Alarm

Rate-of-rise/fixed temperature heat detectors are used in the facility to detect fires. This fire alarm equipment is installed to provide automatic, as well as manual, alarm signals in event of a fire. The system includes an annunciator in the Central Guard Station which indicates which zone in the system has actuated. (See Figure II-10.32.) A signal is also automatically transmitted to the Richland Fire Department. The fire alarm is a multiple-strike gong (two strokes per second). The fire alarm system is inspected and tested in accordance with the applicable preventive maintenance procedures.

10.5.3.6 Fire Defenses

The Exxon Nuclear facilities are located within the city limits of Richland, and thus are served by the Richland Fire Department. The Washington Surveying and Rating Bureau has graded the City as Class 3 in its last survey. The closest City of Richland fire station is located at McMurray and Jadwin, about five road miles from the plant.

The Fire Department estimates running time to the plant to be about six minutes. The City has mutual assistance agreements with surrounding communities, counties, and the DOE (which has a fire station at the Hanford 300 Area located two miles northeast of the plant site). The DOE fire-fighting staff is well trained in nuclear fire safety precautions and has available equipment for radioactive fire fighting. The Richland Fire Department receives annual training in radiological safety precautions from Exxon Nuclear personnel.

The plant site is fed water from the north city water grid through 10-inch diameter water pipes which enter the plant site from the north and south. The plant loop to the hydrants is 8-inch diameter pipe. There are eleven fire hydrants on plant site (see Figure II-10.18). There are Multi-purpose ABC, Halon, Met-L-x, CO_2, BC Dry Chemical, Purple-K Dry Chemical, and AFFF fire extinguishers provided throughout the facility at selected locations. These fire extinguishers are inspected and tested in accordance with the applicable preventive maintenance procedure.

The Exxon Nuclear Plant Emergency Response Teams receive annual training in first aid (or incipient) fire-fighting techniques. The Richland Fire Department has the main responsibility for fighting fires on the plant site.

10.5.3.7 Responsibilities

The Manager, Safety and Security Operations, has the responsibility for inspecting and testing the plant fire extinguishers.

PART II - SAFETY DEMONSTRATION	REV.

The Manager, Plant Maintenance, has the responsibility for inspecting and testing the plant fire alarm system.

PART II - SAFETY DEMONSTRATION

Table II-10.1 Ammonia Recovery Major Equipment

REV.

1.	Stripping Column	38' x 2 ' diameter 22 tray Outlet demister
2.	Feed Tank	11.5' x 8' diameter 3,300 gallons Agitated
3.	Scrubber	Bottom - 10' x 18" diameter 8' packing Top - 10' x 6" diameter 8' packing
4.	Distillate Tank	9' x 3' diameter 400 gallons
5.	Ammonium Hydroxide Storage Tank	24' x 14' diameter 28,000 gallons
6.	Sodium Hydroxide Storage Tank	24' x 14' diameter 28,000 gallons
7.	Cooling Tower	2.5 x 10^6 Btu/hr
8.	Transformer	1000 kVA
9.	Steam Boiler	945 kW

PART II - SAFETY DEMONSTRATION

Table II-10.2 LUR Process Equipment

REV.

Tanks

T-650	Precipitator #1 (6,000 gallon)
T-651	Precipitator #2 (6,000 gallon)
T-652	Precipitator Washer #1 (350 gallon)
T-653	Precipitator Washer #2 (350 gallon)
T-654	Filter Wash Tank #1 (70 gallon)
T-655	Filter Wash Tank #2 (70 gallon)
T-656	Precipitation Agent Mix Tank (50 gallon)
T-660	Dissolver Vessel (100 gallon)
T-661	Dissolver Vessel (100 gallon)
T-662	Dissolver Vessel (100 gallon)
T-663	Dissolver Vessel (100 gallon)

Pumps

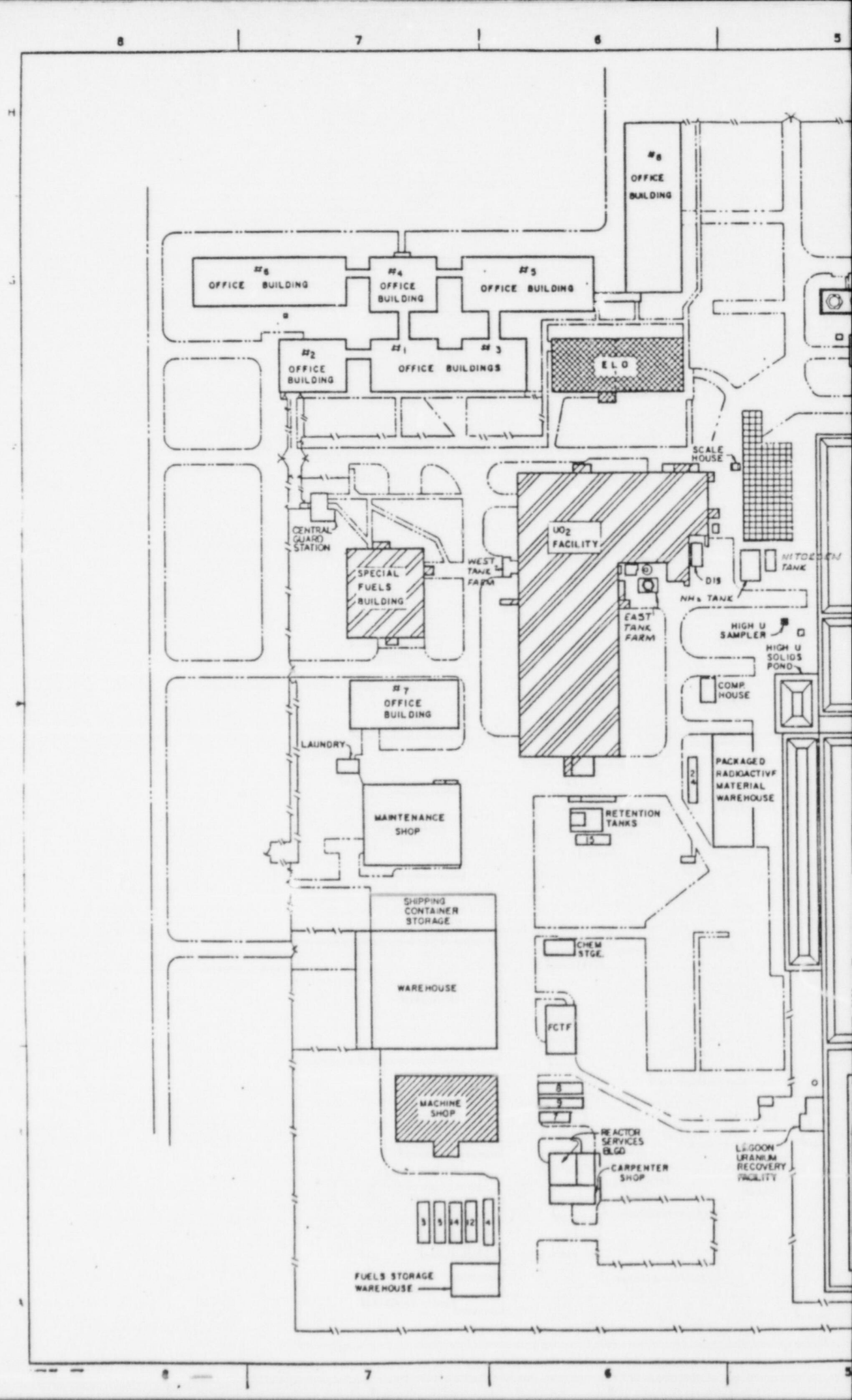
P-650	Precipitator #1 Slurry Pump
P-651	Precipitator #2 Slurry Pump
P-652	Precipitator Washer Decant Pump
P-653.1	Decant Product Pump (portable)
P-653.2	ANN Pump (portable)
P-654	Filter Wash Pump #1
P-655	Filter Wash Pump #2
P-656	Precipitation Agent Makeup Pump
P-657	Precipitation Decant Pump
P-658	Lagoon Waste Feed Pump
P-659	LUR Waste Transfer Pump

Filters

F-652	Washer Decant Filter (25-30 micron)
F-657.1	Precipitation Decant Filter (5-10 micron)
F-657.2	Precipitation Decant Filter (5-10 micron)
F-657.3	Precipitation Decant Filter (1-3 micron)
F-657.4	Precipitation Decant Filter (1-3 micron)
F-658	Lagoon Feed Filter (200 mesh)

Agitators

A-650	Precipitator #1 Agitator
A-651	Precipitator #2 Agitator
A-652	Precipitator Washer #1 Agitator
A-653	Precipitator Washer #2 Agitator
A-654	Filter Washer #1 Agitator
A-655	Filter Washer #2 Agitator
A-656	Mix Tank Agitator


8
7
6
5
H
#8 OFFICE BUILDING
#6 OFFICE BUILDING
#4 OFFICE BUILDING
#5 OFFICE BUILDING
#2 OFFICE BUILDING
#1 OFFICE BUILDINGS
#3
E L O
SCALE HOUSE
CENTRAL GUARD STATION
SPECIAL FUELS BUILDING
WEST TANK FARM
UO2 FACILITY
DIS
NH3 TANK
NITROGEN TANK
EAST TANK FARM
HIGH U SAMPLER
HIGH U SOLIDS POND
COMP HOUSE
#7 OFFICE BUILDING
LAUNDRY
PACKAGED RADIOACTIVE MATERIAL WAREHOUSE
MAINTENANCE SHOP
RETENTION TANKS
SHIPPING CONTAINER STORAGE
WAREHOUSE
CHEM STGE.
FCTF
MACHINE SHOP
REACTOR SERVICES BLDG
CARPENTER SHOP
LAGOON URANIUM RECOVERY FACILITY
FUELS STORAGE WAREHOUSE

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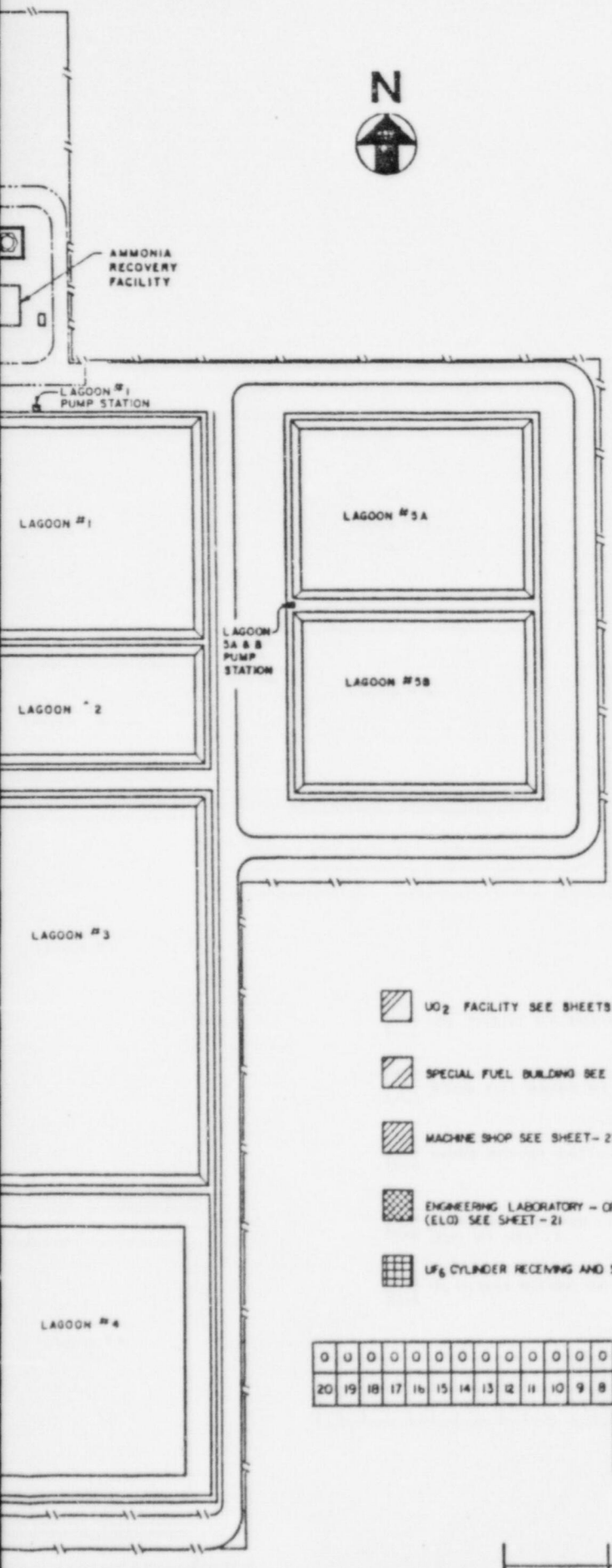

UO_2 FACILITY SEE SHEETS-2

SPECIAL FUEL BUILDING SEE SHEET-16

MACHINE SHOP SEE SHEET-27

ENGINEERING LABORATORY - OPERATIONS BUILDING (ELO) SEE SHEET-21

UF_6 CYLINDER RECEIVING AND STORAGE SEE SHEET-26

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	REV	SHEETS AFFECTED BY REVISION
20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	SHEET	

	0	0	0	0	0	0	0	REV
27	26	25	24	23	22	21	SHEET	

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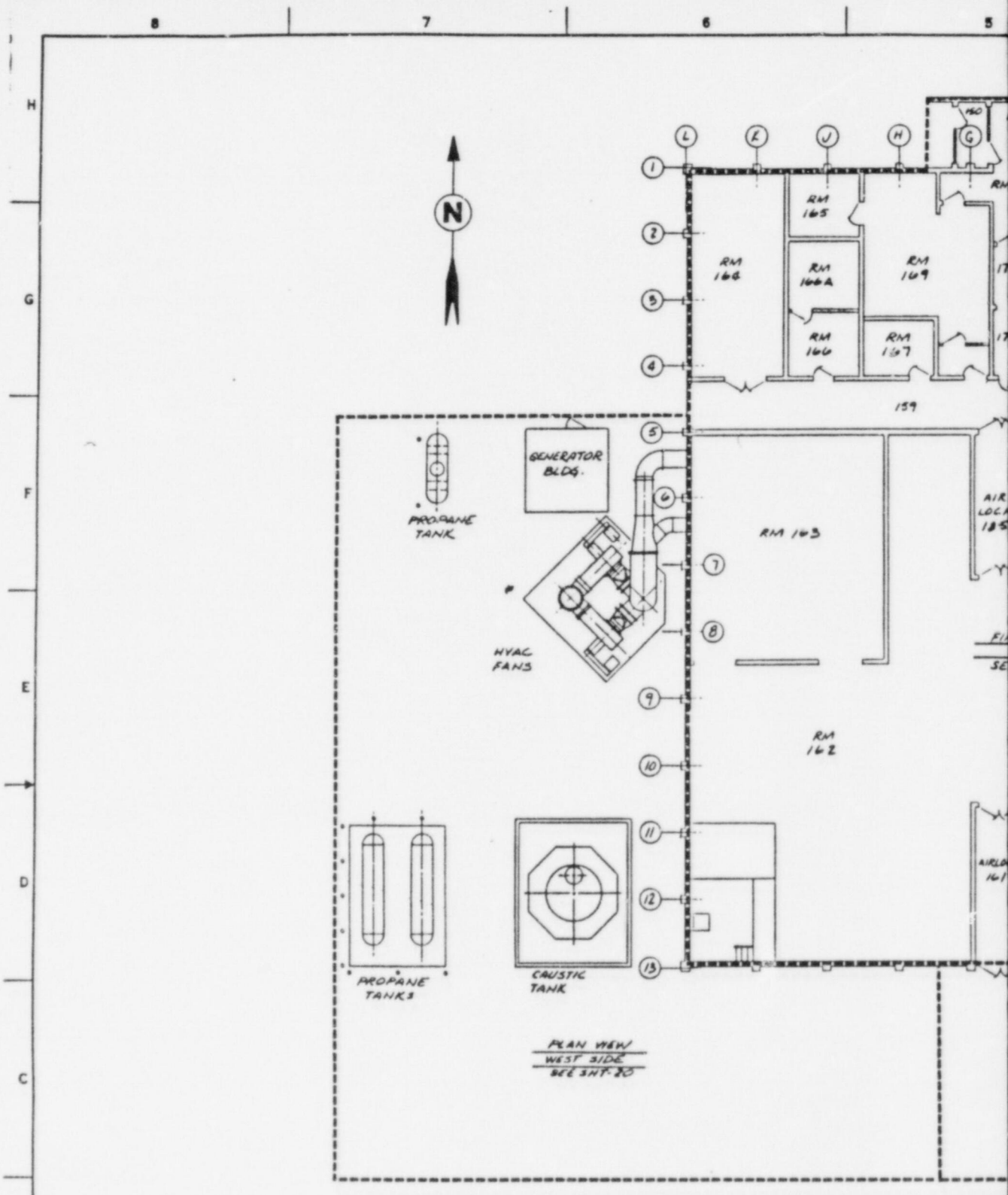
8609260255-02

FIGURE II-10.1

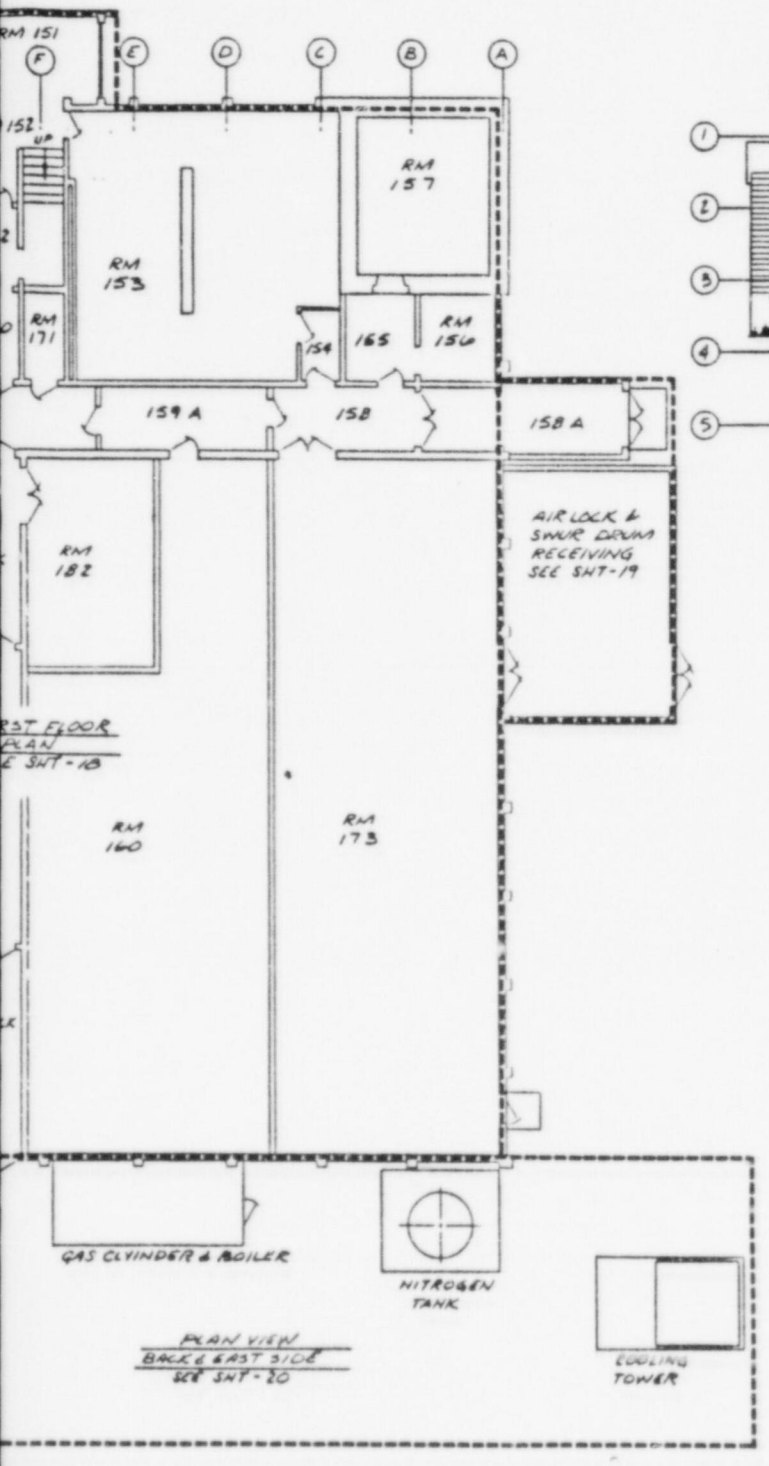
EXXON NUCLEAR COMPANY, Inc.

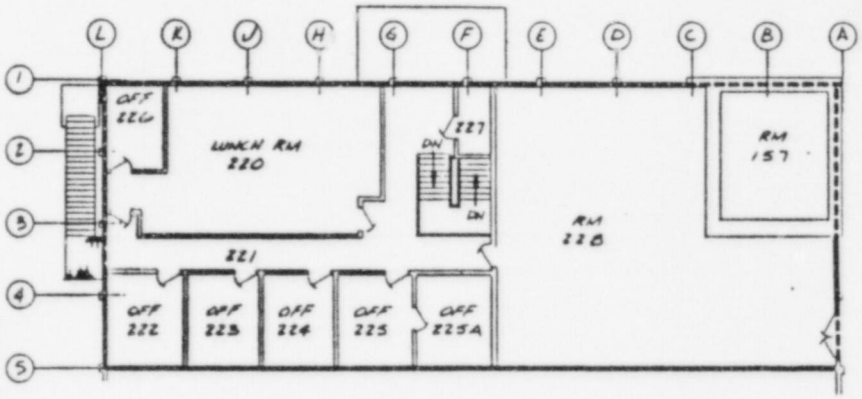
PLANT EQUIPMENT LAYOUT SITE PLAN

XN-607,590 1 27 0


N
RM 165
RM 166
RM 166A
RM 169
RM 166
RM 167
159
GENERATOR BLDG.
PROPANE TANK
HVAC FANS
RM 163
RM 162
PROPANE TANKS
CAUSTIC TANK
PLAN VIEW
WEST SIDE
SEE SHT-20

XN-2, REVISION 13





SECOND FLOOR PLAN
SEE SHT-19

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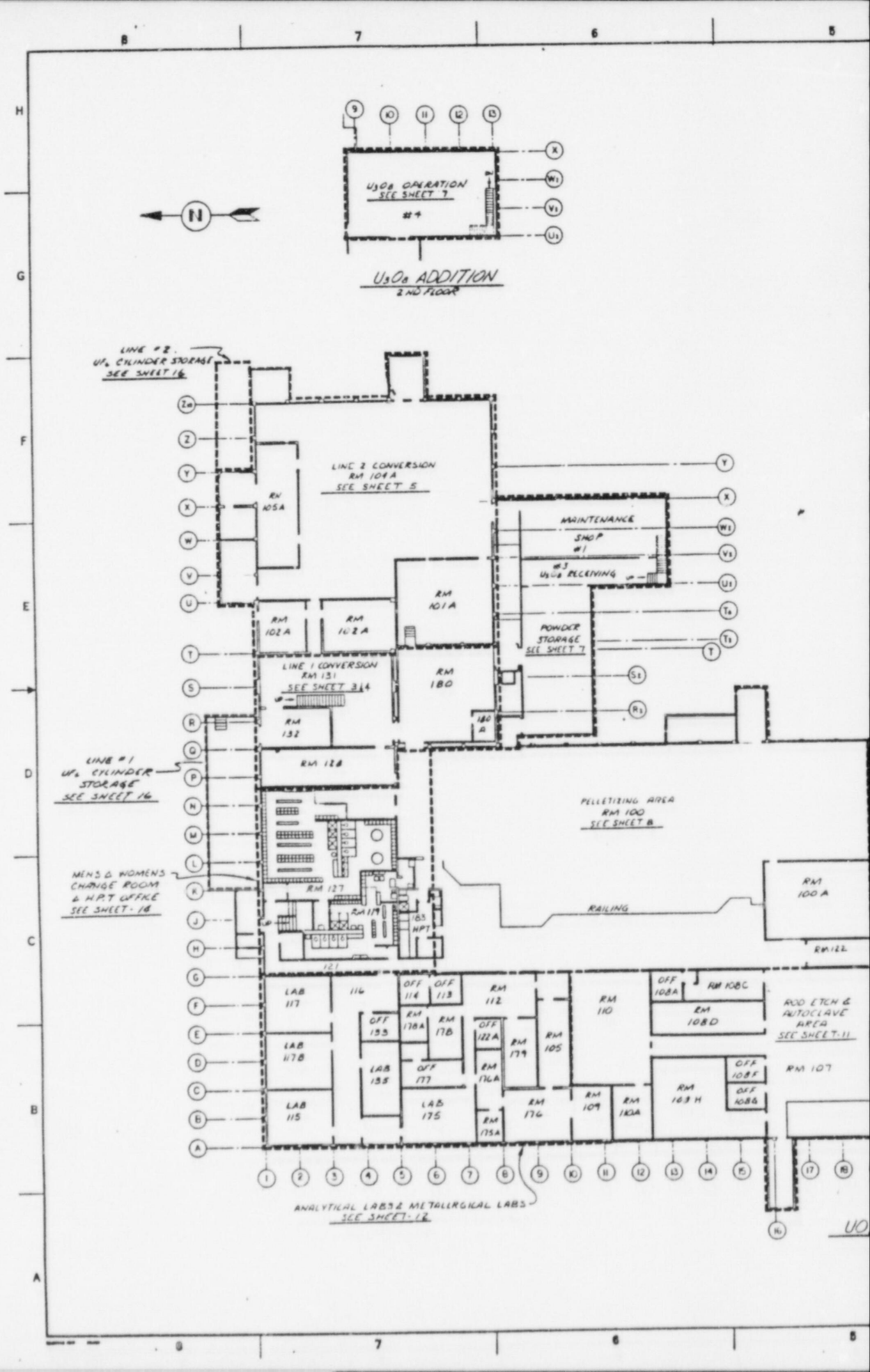
8609260255-03

FIGURE II-10.2

EXXON NUCLEAR COMPANY, INC.
RICHLAND WASHINGTON

PLANT EQUIPMENT LAYOUT SPECIALTY FUEL BLDG.

BISHOP 5-14-86
NONE
XN-607,590
17 27 0


U3O8 OPERATION
SEE SHEET 7
#4
U3O8 ADDITION
2ND FLOOR
LINE #2.
UF6 CYLINDER STORAGE
SEE SHEET 16
LINE 2 CONVERSION
RM 104 A
SEE SHEET 5
RM 105A
MAINTENANCE
SHOP
#1
#3
U3O8 RECEIVING
RM 101A
RM 102A
RM 102A
POWDER
STORAGE
SEE SHEET 7
LINE 1 CONVERSION
RM 131
SEE SHEET 3&4
RM 180
180 A
RM 132
RM 128
LINE #1
UF6 CYLINDER
STORAGE
SEE SHEET 16
PELLETIZING AREA
RM 100
SEE SHEET 8
MEN'S & WOMEN'S
CHANGE ROOM
& H.P.T OFFICE
SEE SHEET-18
RM 127
RM 129
183
HPT
121
RAILING
RM 100 A
RM 122
LAB 117
116
OFF 114
OFF 113
RM 112
OFF 108A
RM 108C
RM 108D
RM 110
ROD ETCH & AUTOCLAVE AREA
SEE SHEET-11
OFF 133
RM 178A
RM 178
OFF 122A
RM 179
RM 105
LAB 117B
LAB 135
OFF 177
RM 176A
OFF 108F
OFF 108G
RM 107
RM 103 H
LAB 115
LAB 175
RM 176
RM 109
RM 180A
RM 175A
ANALYTICAL LABS & METALLURGICAL LABS
SEE SHEET-12
UO

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CARD

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Aperture Card

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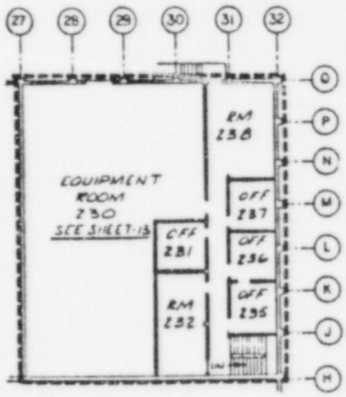
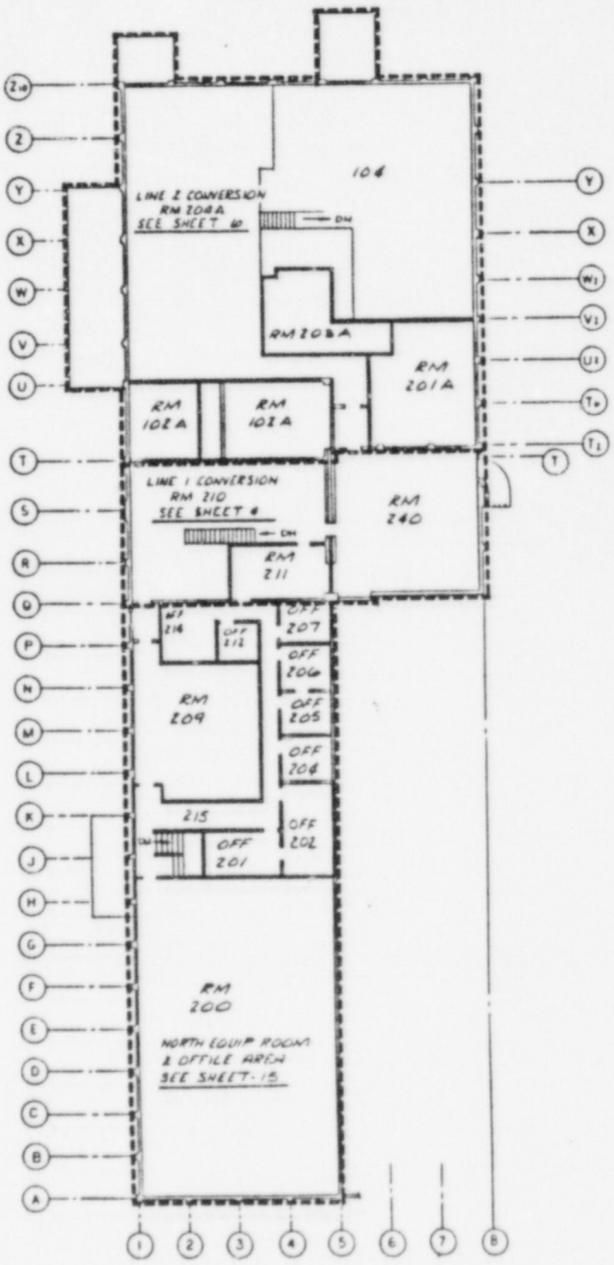
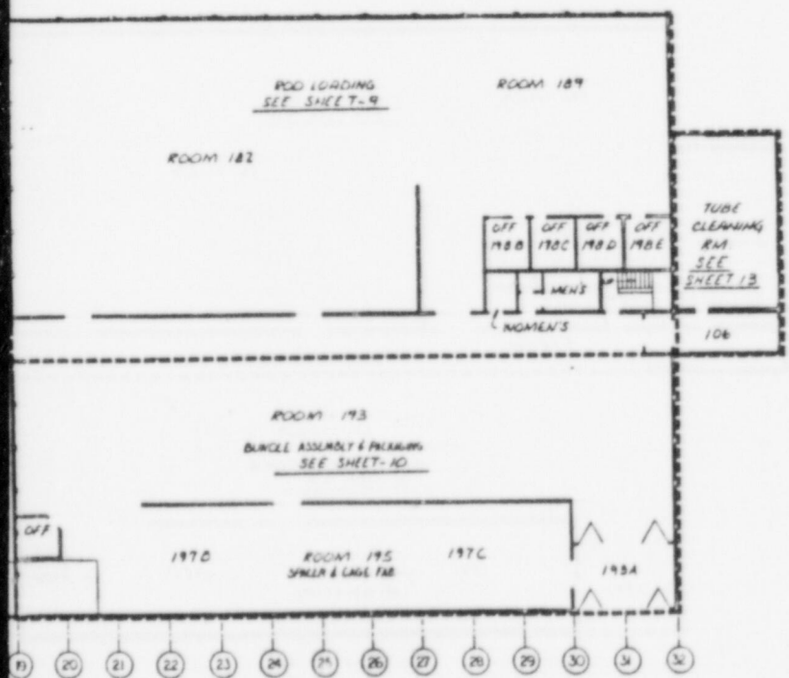


UO_2 BLDG SOUTH END
2ND FLOOR



UO_2 BLDG NORTH END
2ND FLOOR



BLDG PLAN
1ST FLOOR

8809260255-04

FIGURE II-10.3

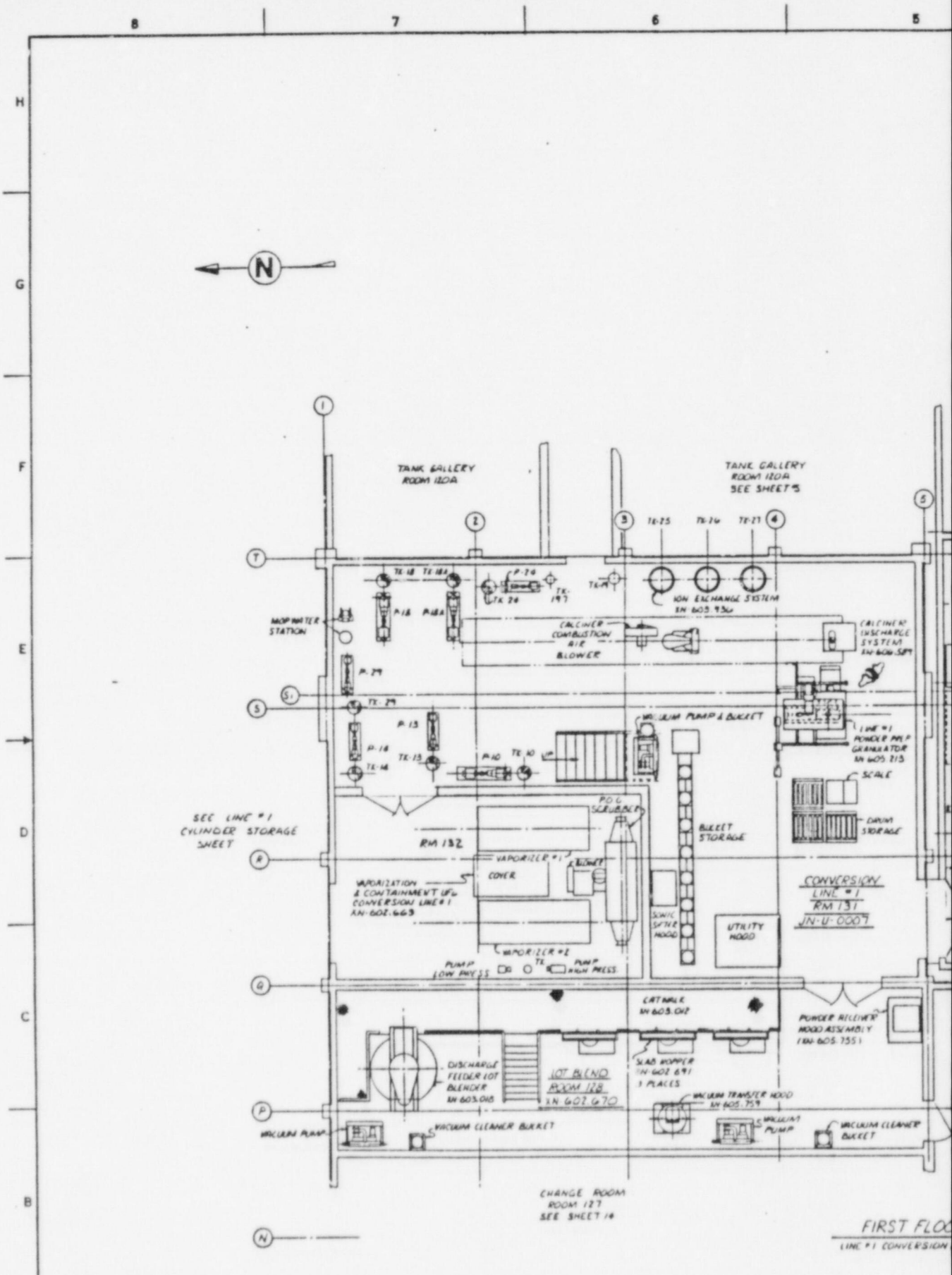
EXXON NUCLEAR COMPANY, INC.

PLANT
EQUIPMENT LAYOUT
UO_2 BLDG

BISHOP 10-3085

XN-607590

2 27 0


N
TANK GALLERY ROOM 120A
TANK GALLERY ROOM 120A SEE SHEET 5
ION EXCHANGE SYSTEM IN 605.934
CALCINER COMBUSTION AIR BLOWER
CALCINER DISCHARGE SYSTEM IN 604.589
MOP WATER STATION
VACUUM PUMP & BURRET
LINE #1 POWDER MILL GRANULATOR IN 605.213
SCALE
DRUM STORAGE
BURRET STORAGE
PDG SCRUBBER
RM 132
VAPORIZER #1
BLOWER
COVER
VAPORIZATION & CONTAINMENT UF6 CONVERSION LINE #1 AN-602.663
SEE LINE #1 CYLINDER STORAGE SHEET
VAPORIZER #2
PUMP LOW PRESS
PUMP HIGH PRESS
SONIC SIFTER HOOD
UTILITY HOOD
CONVERSION LINE #1 RM 131 JN-U-0009
CAT WALK IN 605.042
POWDER RECEIVER HOOD ASSEMBLY (IN-605.755)
DISCHARGE FEEDER LOT BLENDER IN 605.018
LOT BLEND ROOM 128 IN 602.670
SCAB HOPPER IN-602 691 3 PLACES
VACUUM TRANSFER HOOD IN 605.759
VACUUM PUMP
VACUUM CLEANER BURRET
VACUUM PUMP
VACUUM CLEANER BURRET
CHANGE ROOM ROOM 127 SEE SHEET 14
FIRST FLOO
LINE #1 CONVERSION

XN-2, REVISION 13

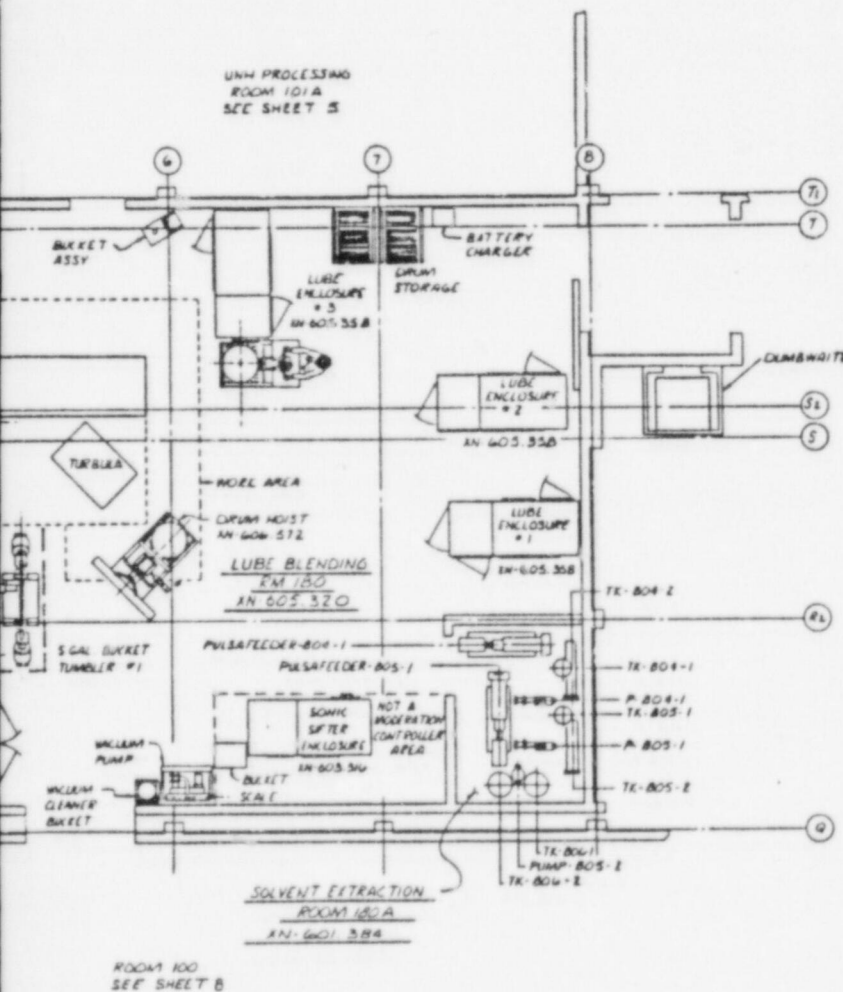


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FIGURE II-10.4

OR PLAN
LUBE BLENDING

QTY	ITEM	DESCRIPTION	REMARKS

APPROVED	BY/DATE	REVISION DESCRIPTION	NO.

EXXON NUCLEAR COMPANY, INC.

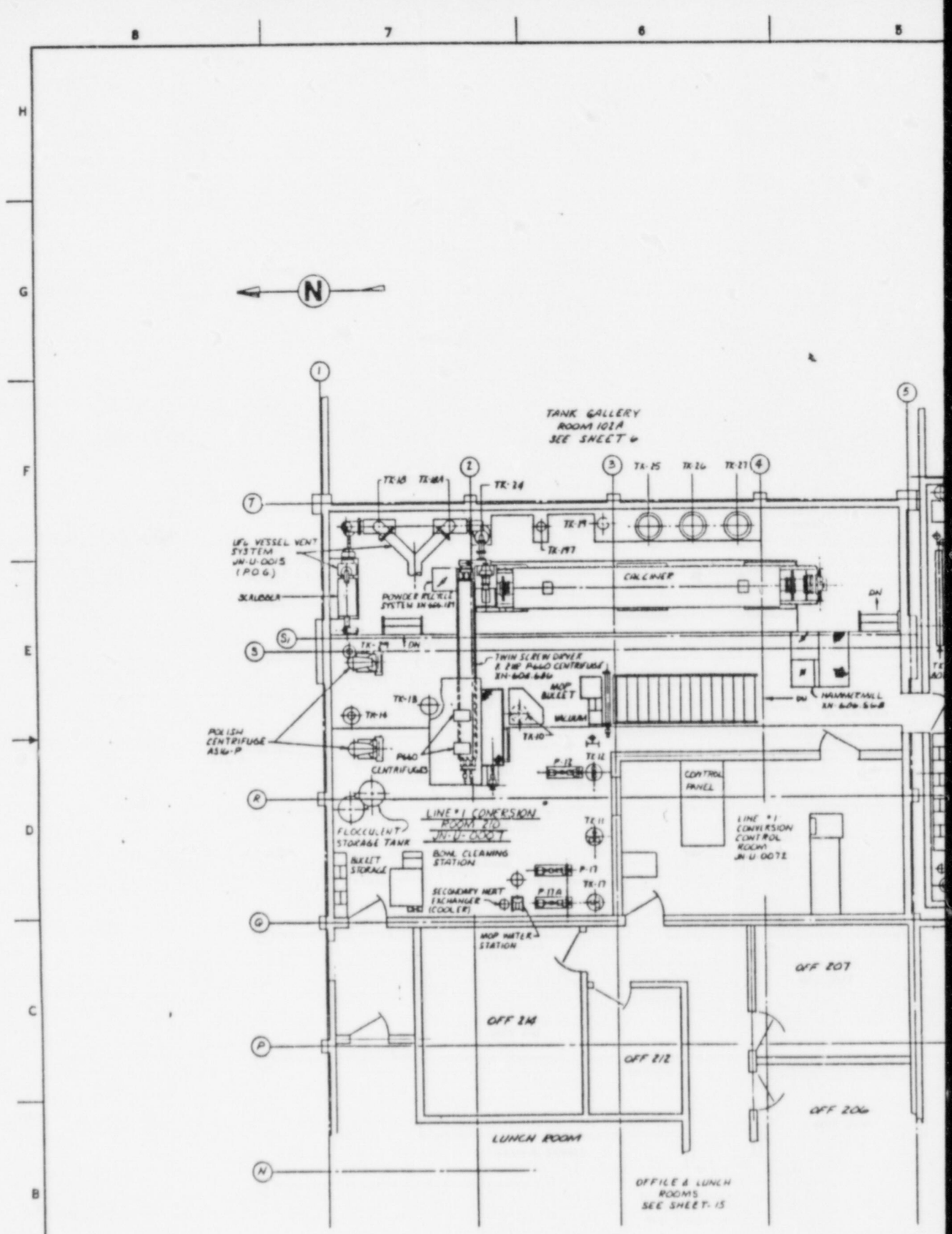
PLANT EQUIPMENT LAYOUT UO2 BLDG.

BISHOP 10-7-85

1"=1'-0"

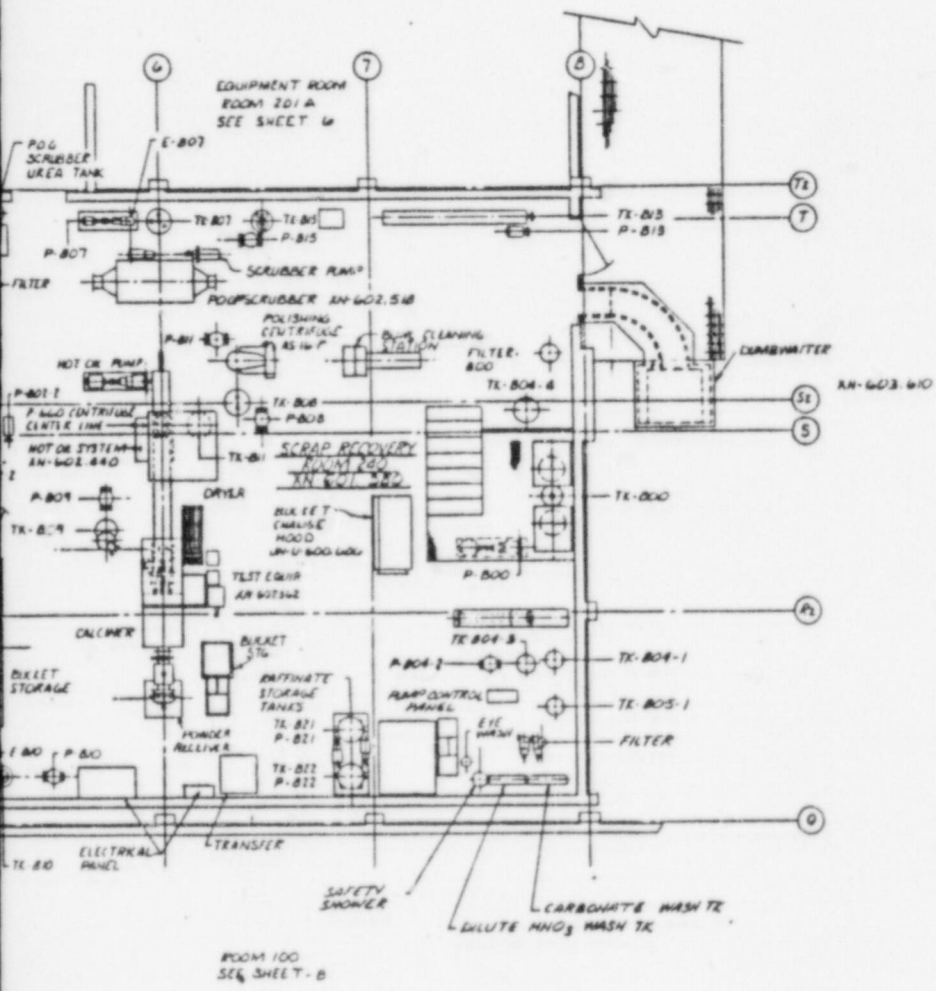
XN-607,590

3 27 0


N
TANK GALLERY
ROOM 102A
SEE SHEET 6
TK-18
TK-18A
TK-24
TK-25
TK-26
TK-27
TK-19
TK-19A
UF6 VESSEL VENT SYSTEM
(P.O.G.)
SCALDER
POWDER RECYCLE SYSTEM
CALCINER
DN
TWIN SCREW DRYER & PAD FILLED CENTRIFUGE
MOP BUCKET
HAMMERMILL
TK-16
TK-10
VALVERA
POLISH CENTRIFUGE
PAD CENTRIFUGE
P-12
TK-12
CONTROL PANEL
LINE #1 CONVERSION
ROOM 210
FLOCCULENT STORAGE TANK
BOWL CLEANING STATION
TK-11
BUCKET STORAGE
P-17
TK-17
SECONDARY HEAT EXCHANGER (COOLER)
P-17A
MOP WATER STATION
LINE #1 CONVERSION CONTROL ROOM
OFF 207
OFF 211
OFF 212
OFF 206
LUNCH ROOM
OFFICE & LUNCH ROOMS
SEE SHEET 15
SECOND FLO
LINE #1 CONERSION
RECOVERY

QTY	ITEM	DESCRIPTION	REMARKS

XN-2, REVISION 13



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CARD

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Aperture Card

8609260255-06

FIGURE II-10.5

OR PLAN
& SCRAP

APPROVED	BRAND	REVISION DESCRIPTION	REV

EXXON NUCLEAR COMPANY, INC.
RICHLAND, WASHINGTON 99352

PLANT
EQUIPMENT LAYOUT
UO_2 BLDG

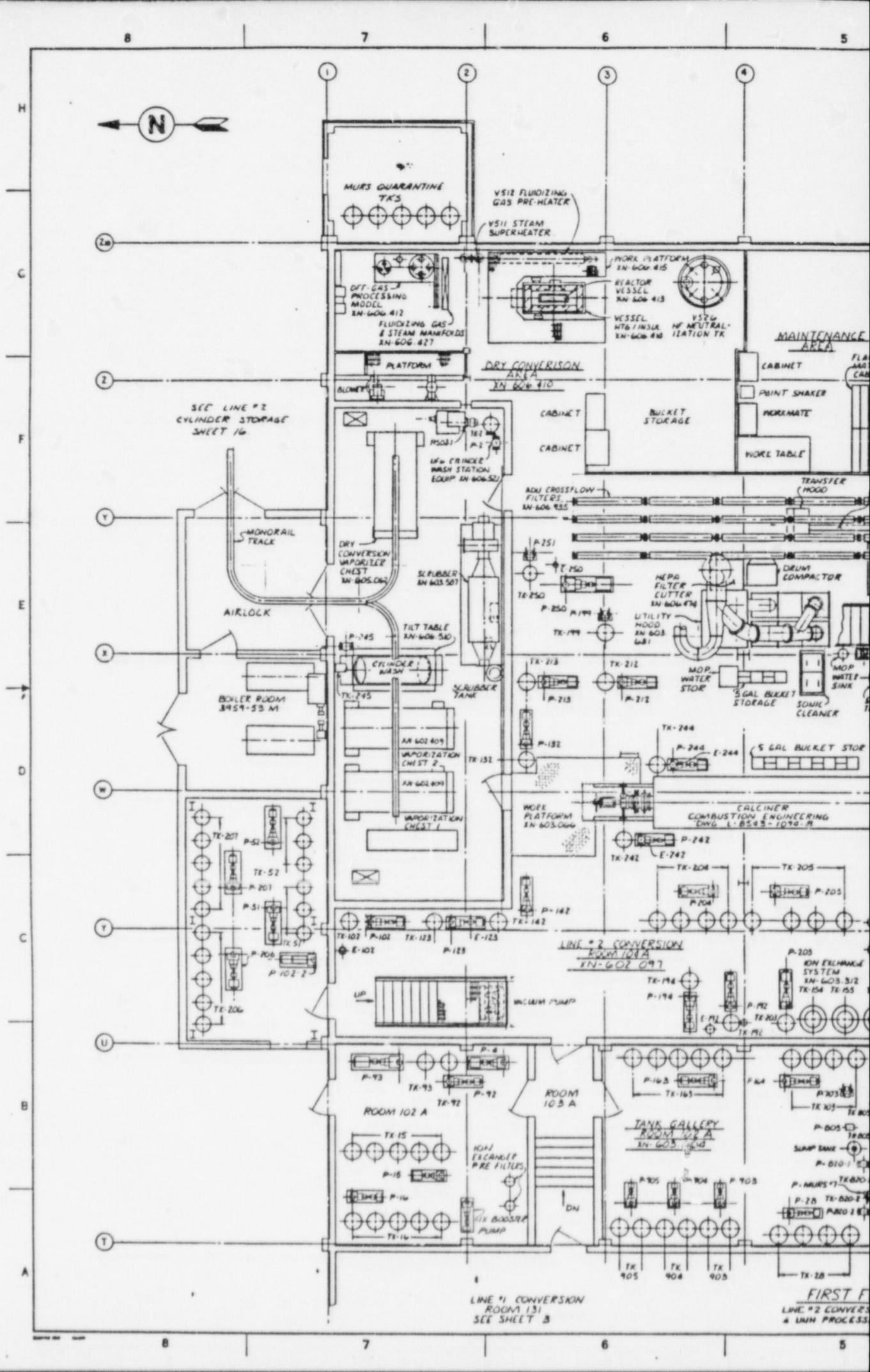
BISHOP 10-14-85

1/16" = 1'-0"

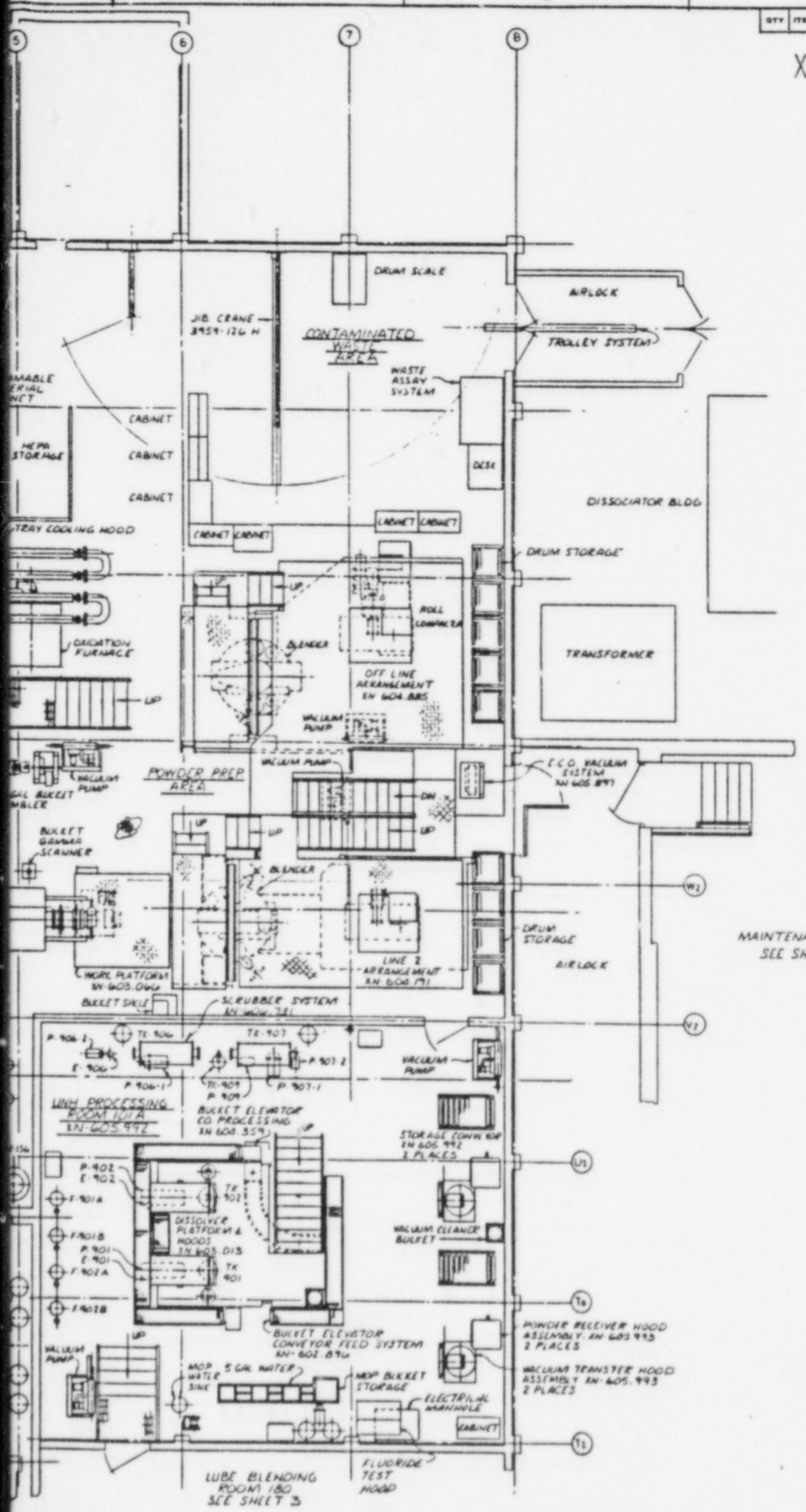
XN-607,590

4

DWG. NO.	REV	REFERENCE DRAWING TITLE


MURS QUARANTINE TK'S
V512 FLUIDIZING GAS PRE-HEATER
V511 STEAM SUPERHEATER
WORK PLATFORM XN-600 415
REACTOR VESSEL XN 606 413
VESSEL MTG / INSUL XN-606 416
V526 HF NEUTRALIZATION TK
OFF-GAS PROCESSING MODEL XN-606 412
FLUIDIZING GAS & STEAM MANIFOLDS XN-606 427
MAINTENANCE AREA
CABINET
PAINT SHAKER
FORKMATE
WORK TABLE
PLATFORM
DRY CONVERSION AREA XN 606 410
BLOWER
SEE LINE #2 CYLINDER STORAGE SHEET 16
CABINET
BUCKET STORAGE
CABINET
M503-1
P-1
TE-1
HF & CRINDER WASH STATION EQUIP XN 606 521
ADU CROSSFLOW FILTERS XN 606 935
TRANSFER HOOD
MONORAIL TRACK
DRY CONVERSION VAPORIZER CHEST XN 605.062
SCRUBBER XN 603 507
P-251
TE-250
TX-250
P-250
HEPA FILTER CUTTER XN 606 476
DRUM COMPACTOR
P-199
TX-199
UTILITY HOOD XN 603 681
AIRLOCK
TILT TABLE XN-606 540
P-245
CYLINDER WASH
TX-245
SCRUBBER TANK
TX-213
TX-212
P-213
P-212
MOP WATER STOR
5 GAL BUCKET STORAGE
SONIC CLEANER
MOP WATER SINK
BOILER ROOM 3459-53 M
TX-244
P-244
E-244
5 GAL BUCKET STOR
XN 602 409
VAPORIZATION CHEST 2
XN 602 409
TX 132
P-132
VAPORIZATION CHEST 1
WORK PLATFORM XN 603.066
CALCINER COMBUSTION ENGINEERING DWG L-8565-1090-A
P-242
E-242
TX-242
TX-207
P-52
TX-52
P-201
P-51
TX-51
P-206
P-102-2
TX-206
TX-204
TX-205
P-204
P-205
P-142
TX-142
TX-102
P-102
E-102
TX-123
P-123
E-123
LINE #2 CONVERSION ROOM 108A XN-602 097
P-205
ION EXCHANGE SYSTEM XN-603.312
TX-154
TX-155
TX-194
P-194
P-192
E-192
TX-192
TX-191
UP
VACUUM PUMP
P-4
P-93
TX-93
TX-92
P-92
ROOM 102 A
ROOM 103 A
P-163
TX-163
P-164
P-103
TX-103
TANK GALLERY ROOM 104 A XN-603 640
P-605
SUMP TANK
P-810-1
TX 15
ION EXCHANGE PRE FILTERS
P-15
P-16
TX-16
TX 800 STA PUMP
DN
P-905
P-904
P-903
TX 905
TX 904
TX 903
P-MURS #7
TX-820-1
P-28
TX-820-2
P-820-2
TX-28
LINE #1 CONVERSION ROOM 131 SEE SHEET 3
FIRST F
LINE #2 CONVERS
& UNH PROCESS

XN-2, REVISION 13



TI APERTURE CARD

Also Available On Aperture Card

8609260255-07

FIGURE II-10.6

EXXON NUCLEAR COMPANY, INC.

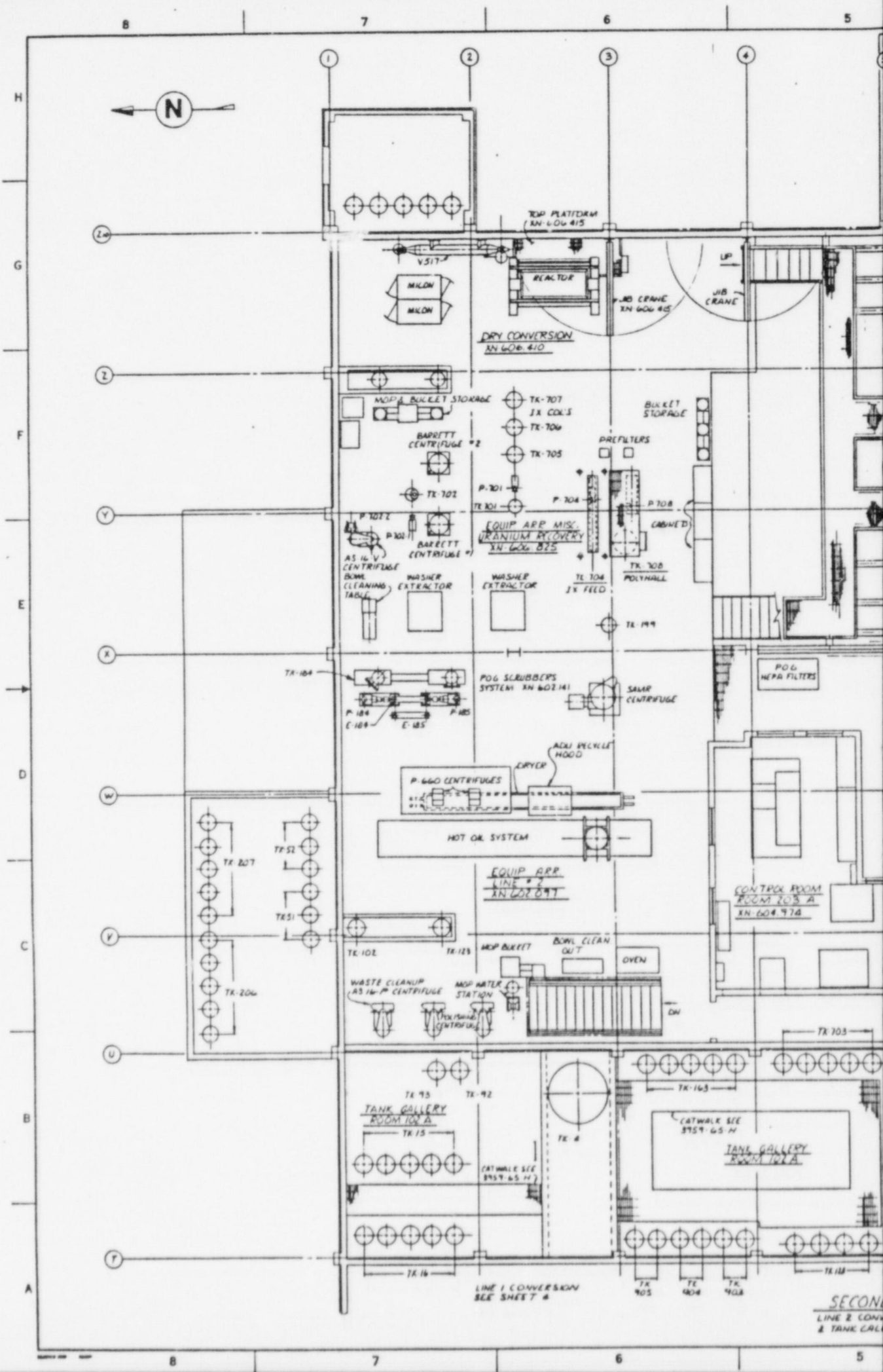
PLANT EQUIPMENT LAYOUT UO_2 BLDG

XN-607.590

3959-A-61 | 1ST FLOOR PLAN

B-SHOP 10-25-85

1/4"=1'-0"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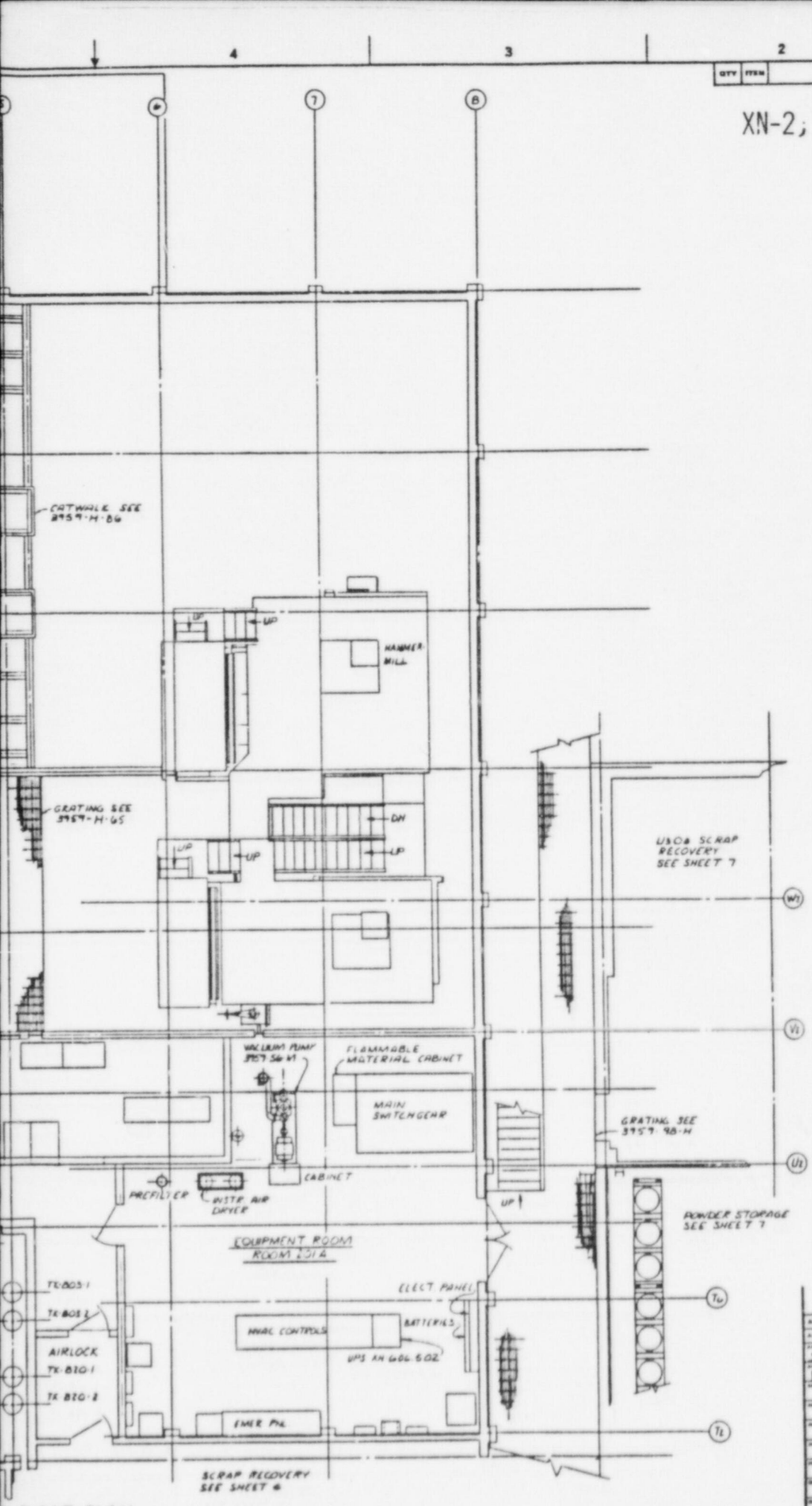
3
4
N
TOP PLATFORM (XN-606 415)
V-517
MILON
MILON
REACTOR
JIB CRANE XN 606 415
JIB CRANE
UP
DRY CONVERSION XN 606 410
MOP & BUCKET STORAGE
TK-707 2 X COLS
TK-706
TK-705
BUCKET STORAGE
BARRETT CENTRIFUGE #2
PREFILTERS
TK-702
P-701
TK 701
P-704
P-708
CABINETS
P-702
P-703
EQUIP. A.R.P. MISC. URANIUM RECOVERY XN-606 825
BARRETT CENTRIFUGE #1
AS 16 V CENTRIFUGE
BOWL CLEANING TABLE
WASHER EXTRACTOR
WASHER EXTRACTOR
TK 704 2 X FEED
TK-708 POLYHALL
TK-199
TK-184
P-184
E-184
E-185
P-185
POG SCRUBBERS SYSTEM XN 602 141
SAMR CENTRIFUGE
POG HEPA FILTERS
ACID PICKLE HOOD
DRYER
P-660 CENTRIFUGES
HOT OIL SYSTEM
EQUIP. A.R.P. LINE #2 XN 602 699
CONTROL ROOM ROOM 203 A XN-604 976
TK-207
TK-52
TK-51
TK-206
TK-102
TK-128
MOP BUCKET
BOWL CLEAN OUT
OVEN
WASTE CLEANUP AS 16 P CENTRIFUGE
MOP WATER STATION
POLISHING CENTRIFUGE
ON
TK-703
TK-93
TK-92
TK-163
TANK GALLERY ROOM 104 A
TK-15
CATWALK SEE 3959-65-H
TK-4
CATWALK SEE 3959-65-H
TANK GALLERY ROOM 102 A
TK-16
LINE 1 CONVERSION SEE SHEET 6
TK 905
TK 904
TK 908
TK-118
SECON
LINE 2 CON
& TANK GAL

XN-2; REVISION 13



FLOOR PLAN
ERSION. EQUIPMENT ROOM
LERY

TI APERTURE CARD

Also Available On Aperture Card

8609260255-08

FIGURE II-10.7

EXXON NUCLEAR COMPANY, INC.

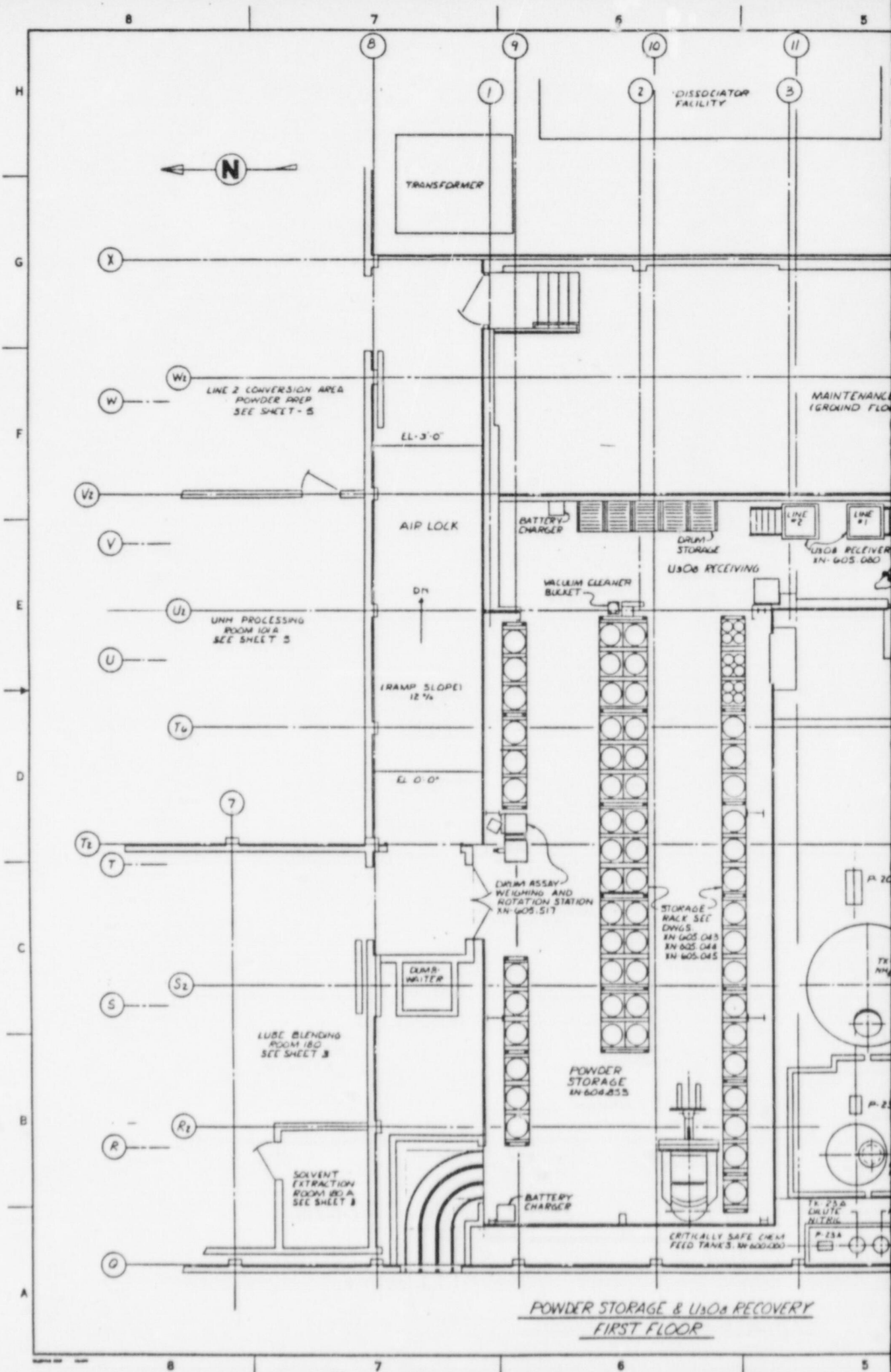
PLANT EQUIPMENT LAYOUT UO2 BLDG

BISHOP 10-30-85

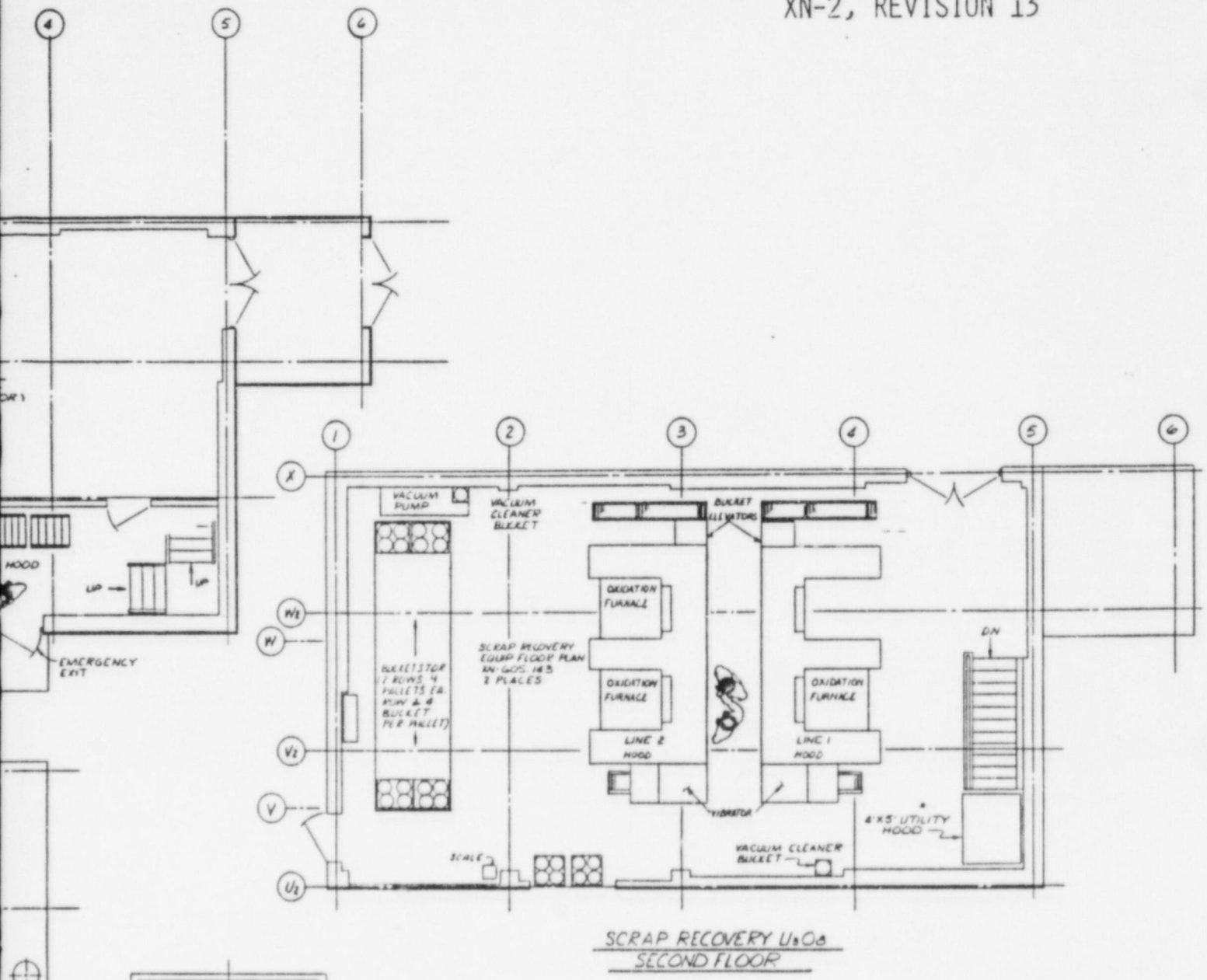
1/4"-1'-0"

XN-607,590

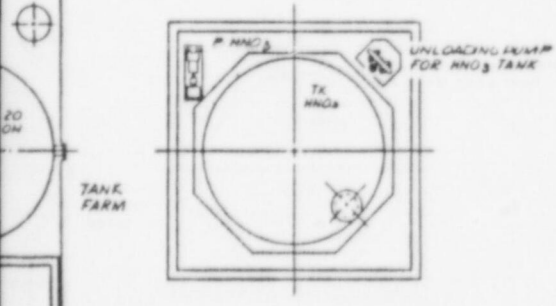
6 27 0


N
TRANSFORMER
DISSOCIATOR FACILITY
LINE 2 CONVERSION AREA POWDER PREP SEE SHEET - 5
EL-3'-0"
AIR LOCK
BATTERY CHARGER
DRUM STORAGE
LINE #2
LINE #1
UNH PROCESSING ROOM 101A SEE SHEET 5
VACUUM CLEANER BUCKET
(RAMP SLOPE) 12 %
EL 0'-0"
DRUM ASSAY WEIGHING AND ROTATION STATION XN-605-517
STORAGE RACK SEE DWGS. XN 605-043 XN 605-044 XN 605-045
DUMB WAITER
LUBE BLENDING ROOM 180 SEE SHEET 3
POWDER STORAGE XN 604-853
SOLVENT EXTRACTION ROOM 180A SEE SHEET 3
BATTERY CHARGER
CRITICALLY SAFE CHEM FEED TANKS XN 600-200
POWDER STORAGE & U3O8 RECOVERY
FIRST FLOOR

XN-2, REVISION 13



SCRAP RECOVERY U_3O_8
SECOND FLOOR



8609260255-09

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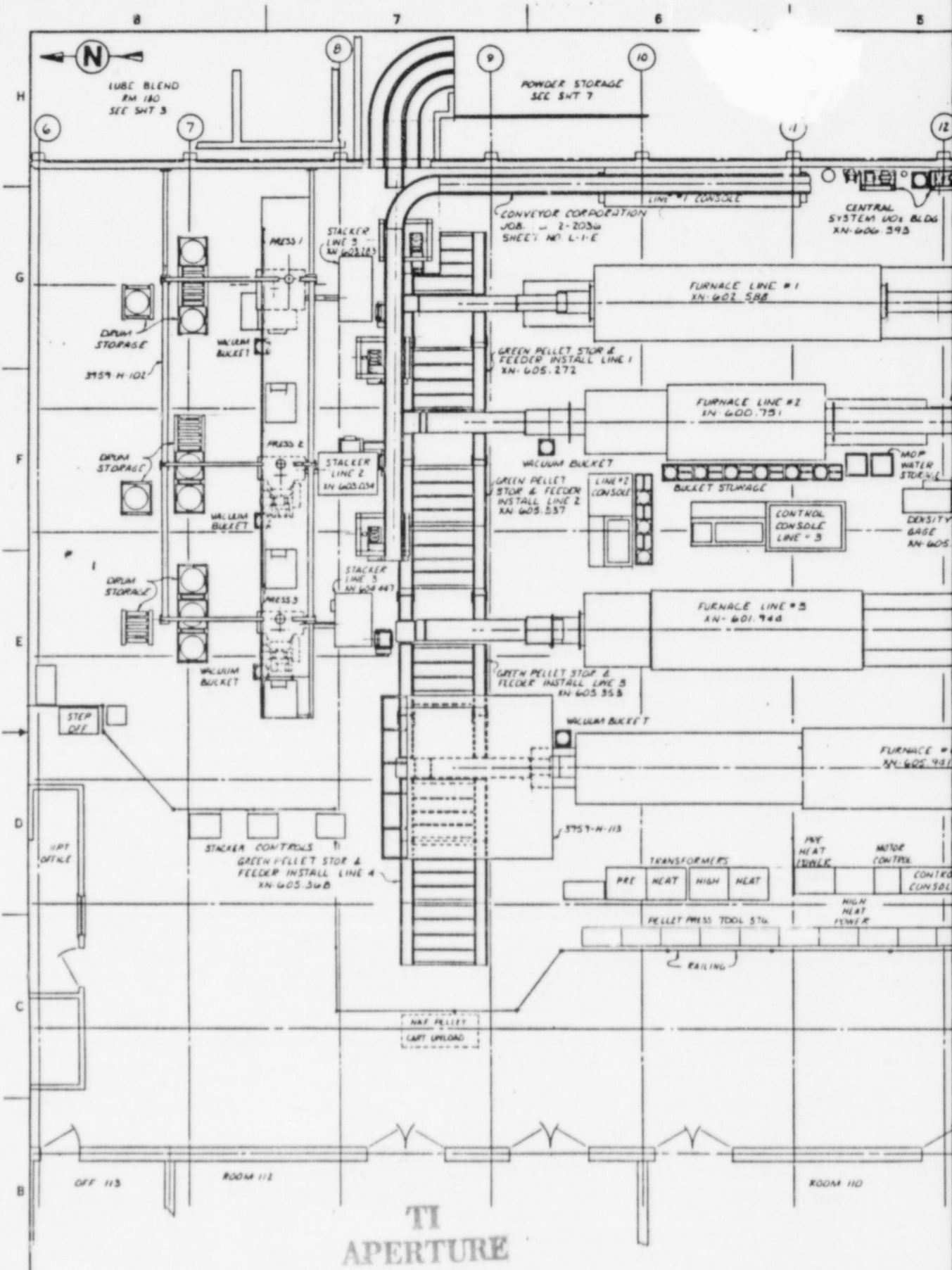
Also Available On Aperture Card

FIGURE II-10.8

EXXON NUCLEAR COMPANY, INC.			
PLANT EQUIPMENT LAYOUT UO_2 BLDG			
DRAWN BY: BISHOP 7-30-85	SCALE: 1/4" = 1'-0"	XN-607,590	7 27 0



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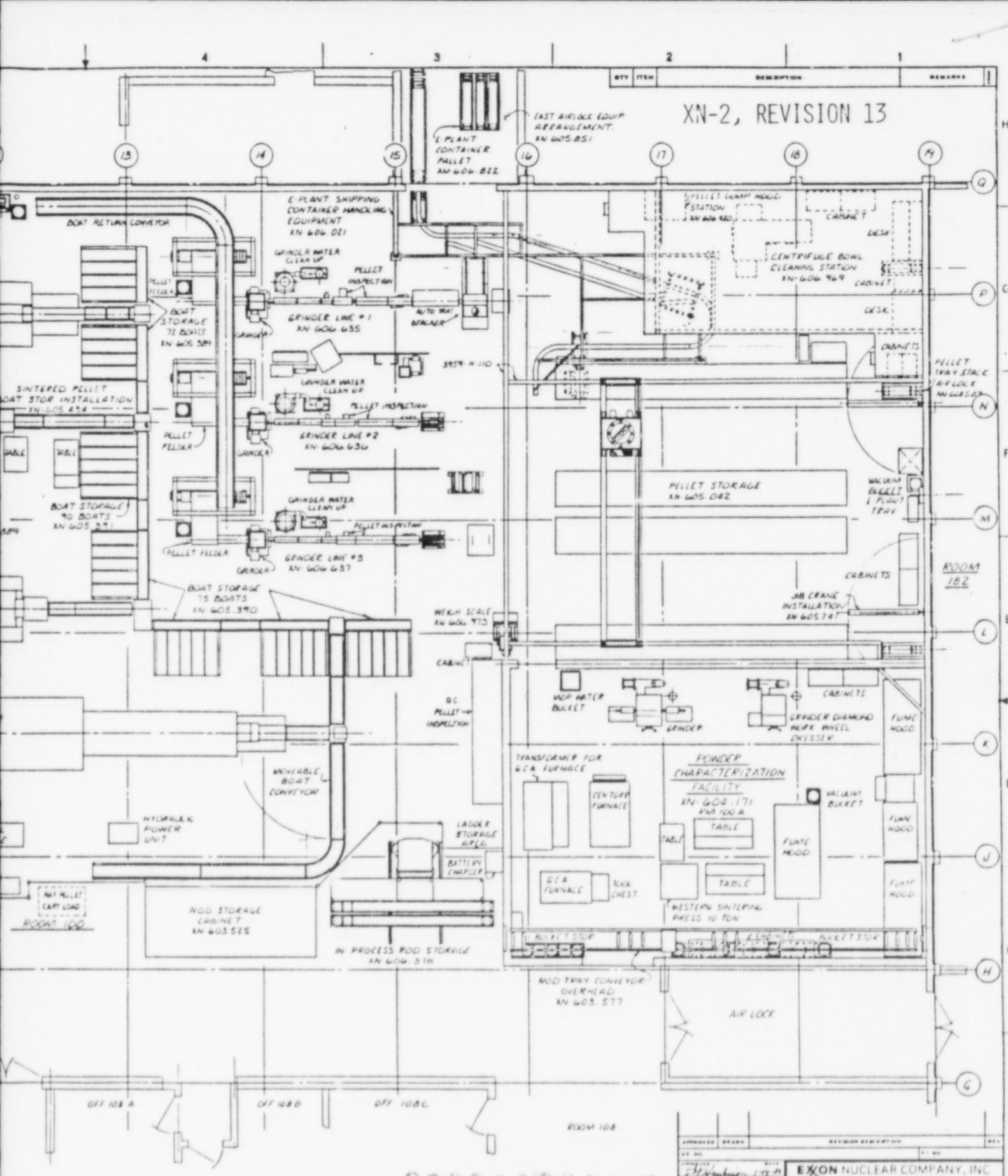
CARD

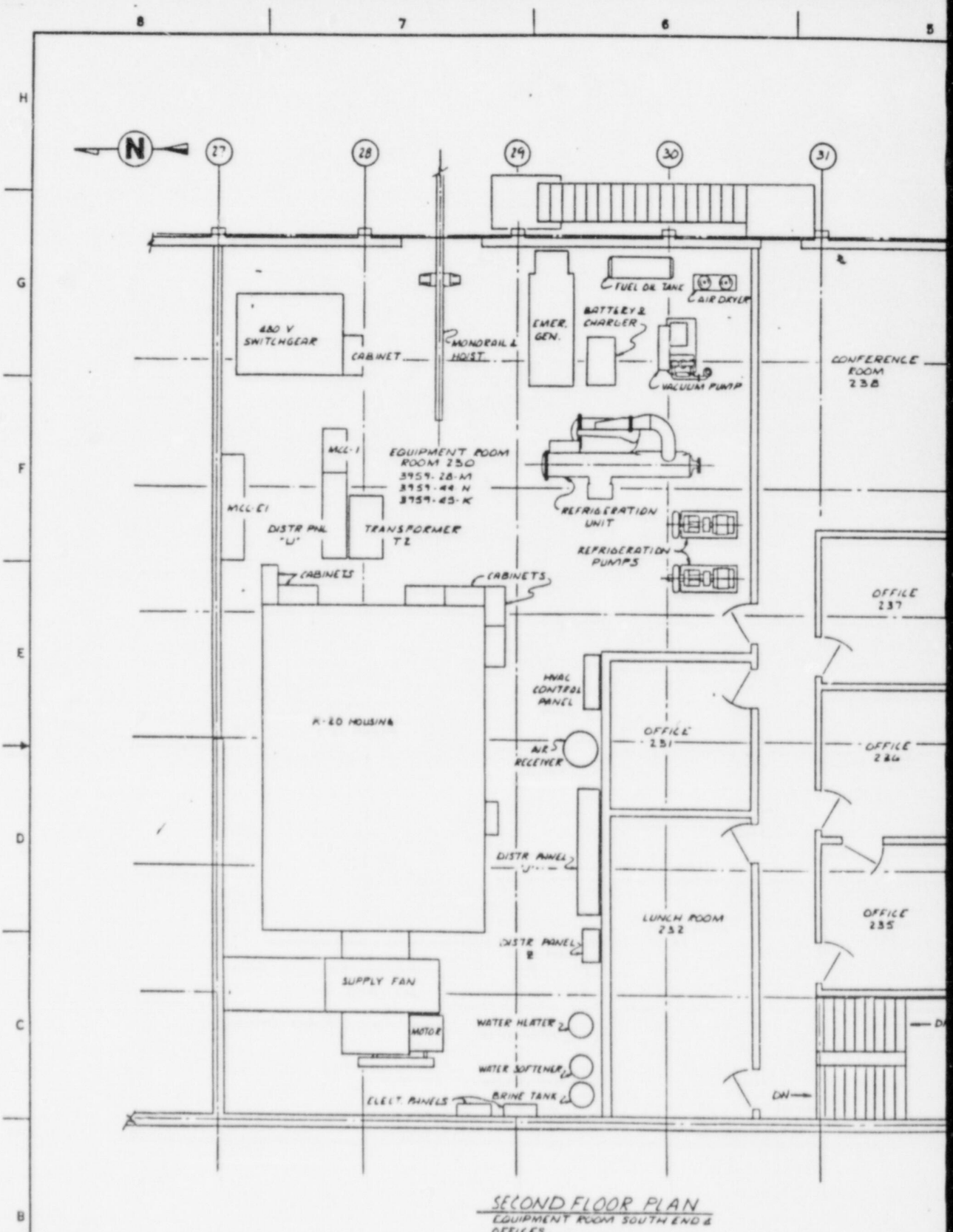
Also Available On
Aperture Card



8609260255-10

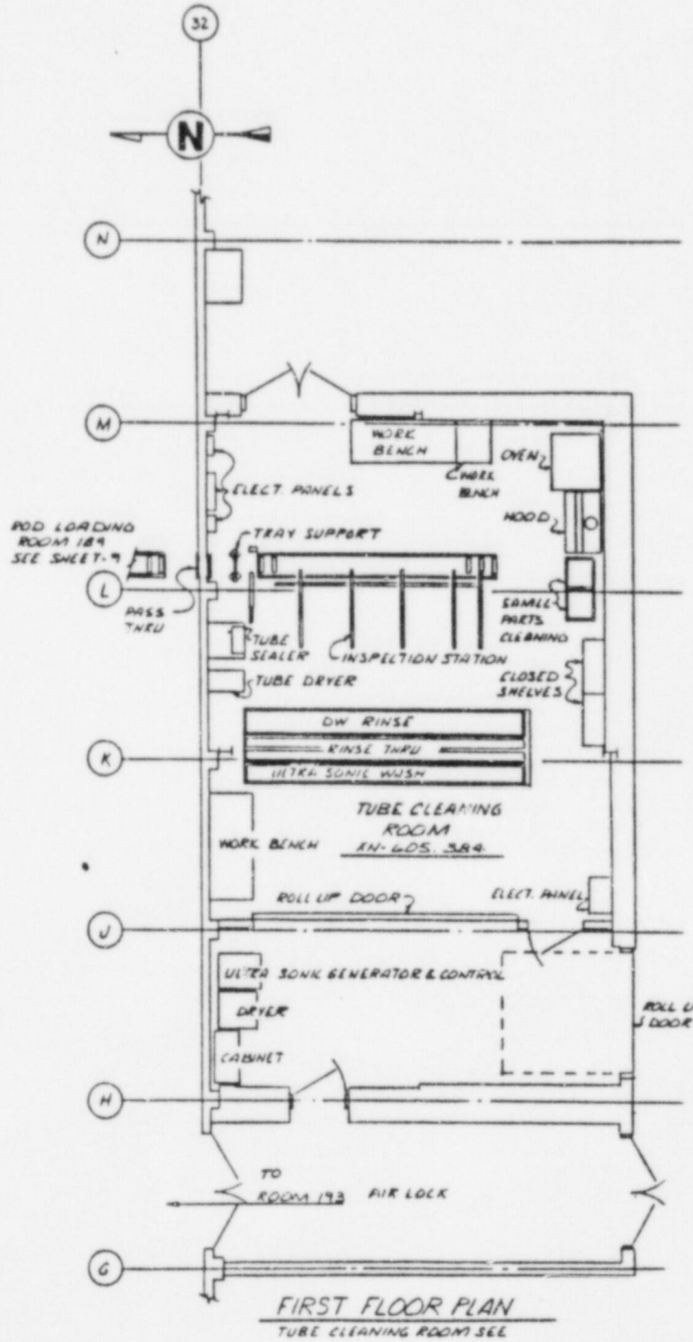
FIGURE II-10.9

ST FLOOR PLAN
TILING AREA ROOM 100



SECOND FLOOR PLAN
EQUIPMENT ROOM SOUTH END & OFFICES

XN-2, REVISION 13



FIRST FLOOR PLAN
TUBE CLEANING ROOM SEE

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CARD

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Aperture Card

8609260255-11

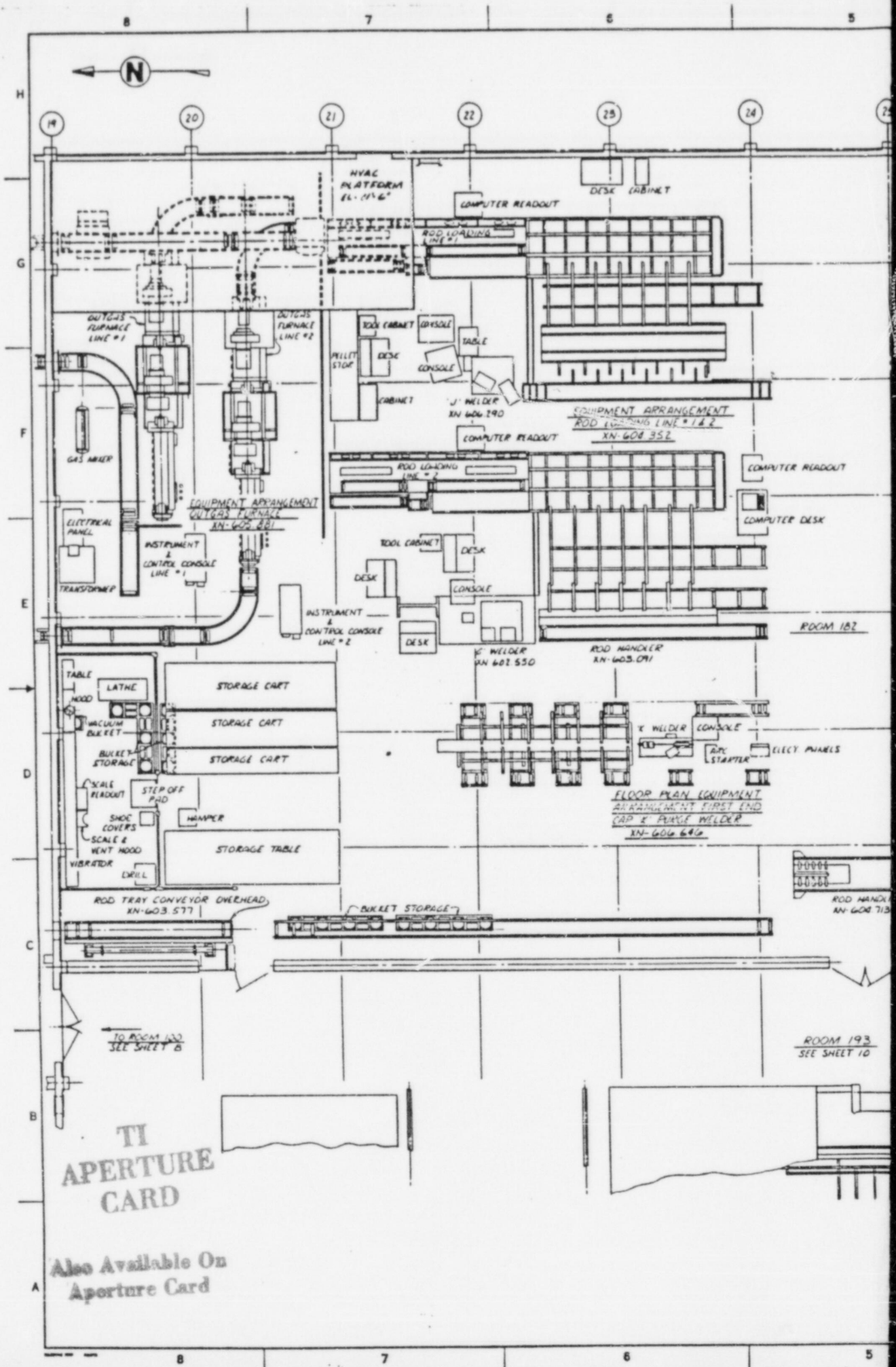
FIGURE II-10.10

EXXON NUCLEAR COMPANY, INC.

PLANT
EQUIPMENT LAYOUT
UO_2 BLDG

XN-607590

13 27 0



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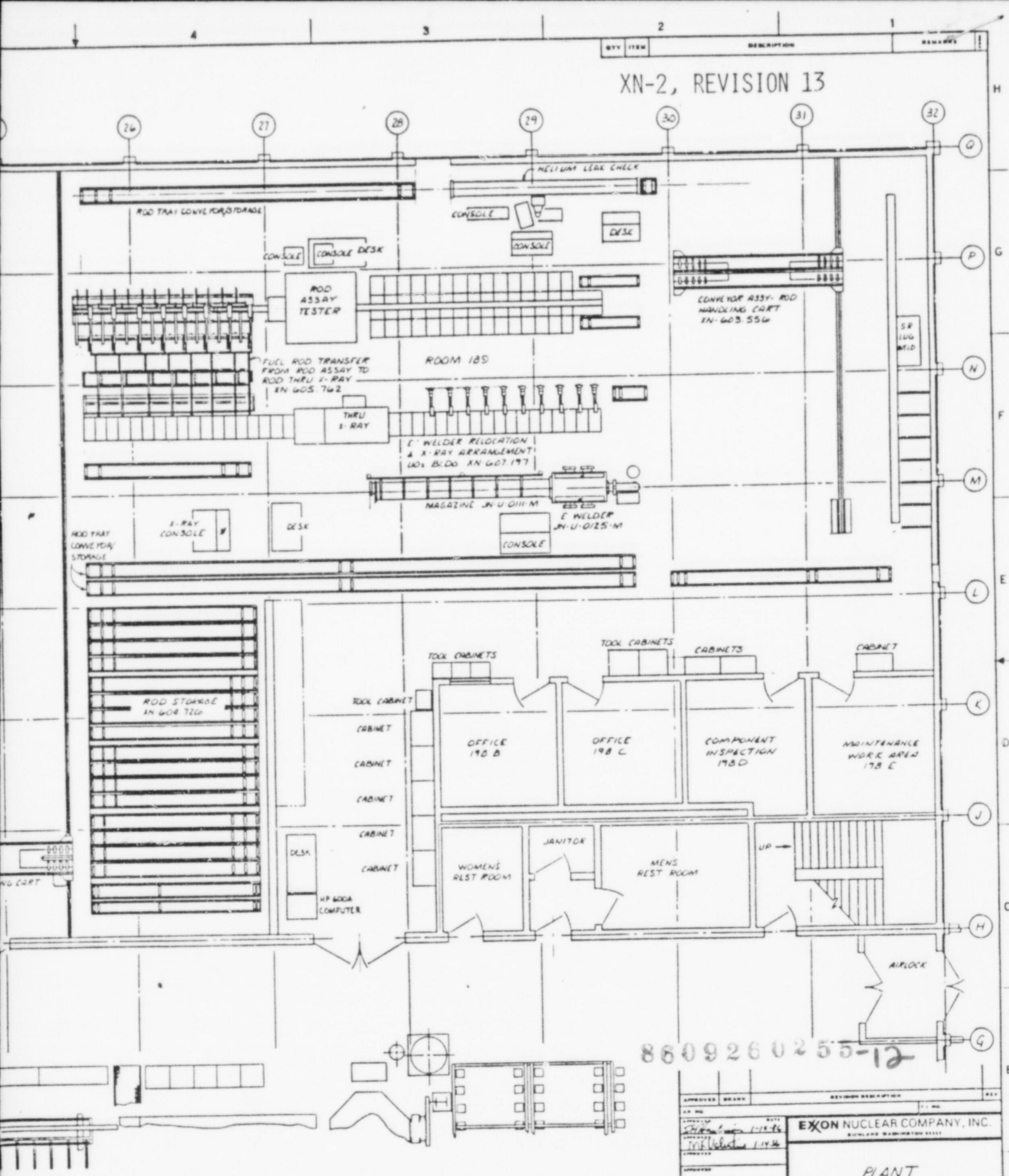
Also Available On Aperture Card



8609260255-12

FIRST FLOOR PLAN
ROD LOADING, WELDING & ASSAY

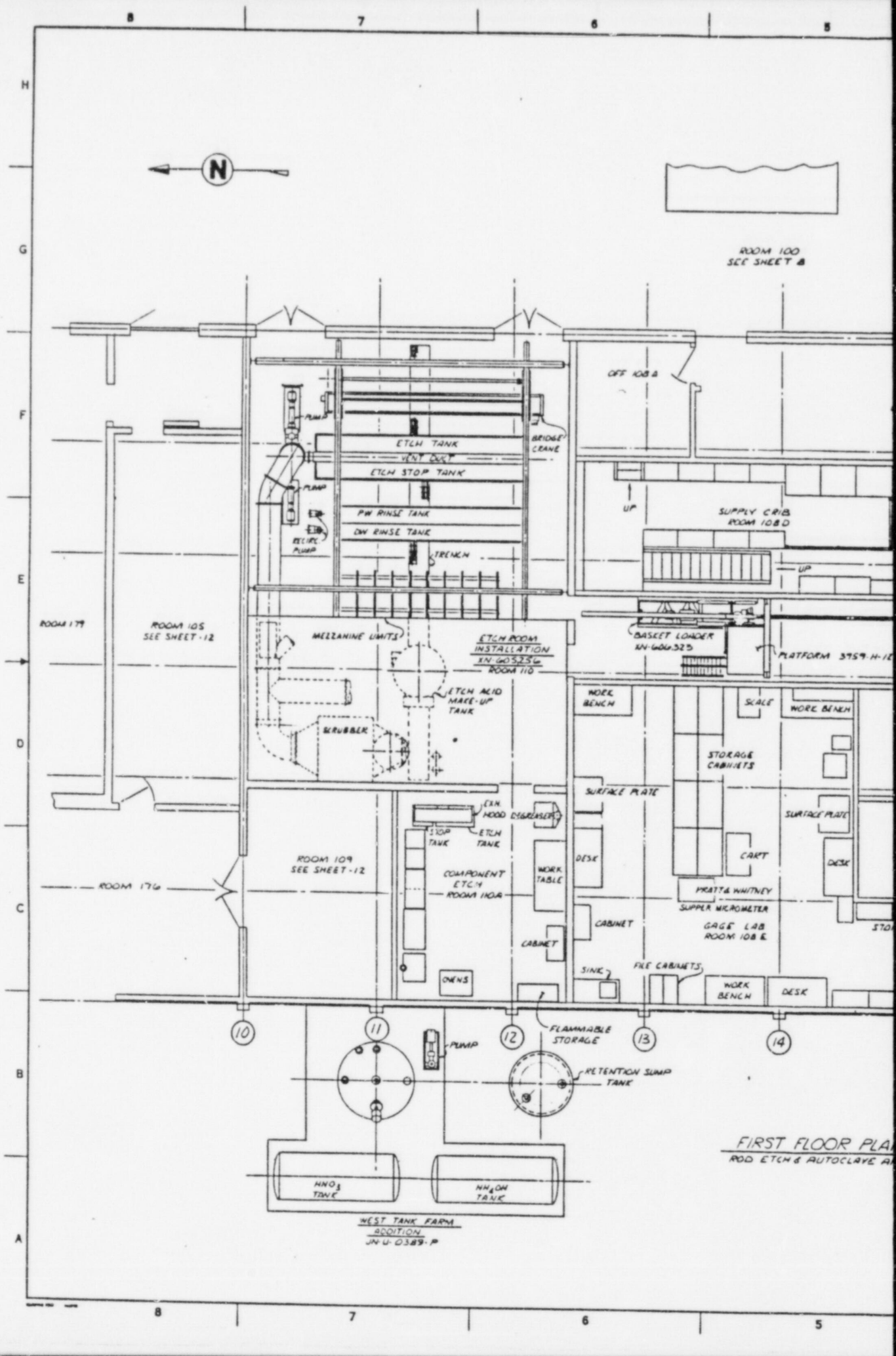
FIGURE II-10.11

EXXON NUCLEAR COMPANY, INC.

PLANT EQUIPMENT LAYOUT UO2 BLDG

XN-607.590

9 27 0


N
ROOM 100
SEE SHEET 8
OFF 108A
PUMP
ETCH TANK
VENT DUCT
ETCH STOP TANK
PUMP
PW RINSE TANK
DW RINSE TANK
RECIRC PUMP
TRENCH
BRIDGE CRANE
UP
SUPPLY CRIB
ROOM 108D
UP
ROOM 179
ROOM 105
SEE SHEET-12
MEZZANINE UNITS
ETCH ROOM
INSTALLATION
XN 605256
ROOM 110
BASKET LOADER
XN-666323
PLATFORM 3959-H-12
ETCH ACID
MAKE-UP
TANK
SCRUBBER
WORK
BENCH
SCALE
WORK BENCH
STORAGE
CABINETS
SURFACE PLATE
SURFACE PLATE
CHM.
HOOD
DEGREASER
STOP
TANK
ETCH
TANK
ROOM 109
SEE SHEET-12
ROOM 176
COMPONENT
ETCH
ROOM 110A
WORK
TABLE
DESK
CART
DESK
PRATT & WHITNEY
SUPPER MICROMETER
CABINET
GAGE LAB
ROOM 108E
CABINET
SINK
FILE CABINETS
OVENS
WORK
BENCH
DESK
10
11
12
13
14
FLAMMABLE
STORAGE
PUMP
RETENTION SUMP
TANK
HNO_3
TANK
NH_4OH
TANK
WEST TANK FARM
ADDITION
JN-U-0389-P
FIRST FLOOR PLA
ROD ETCH & AUTOCLAVE A
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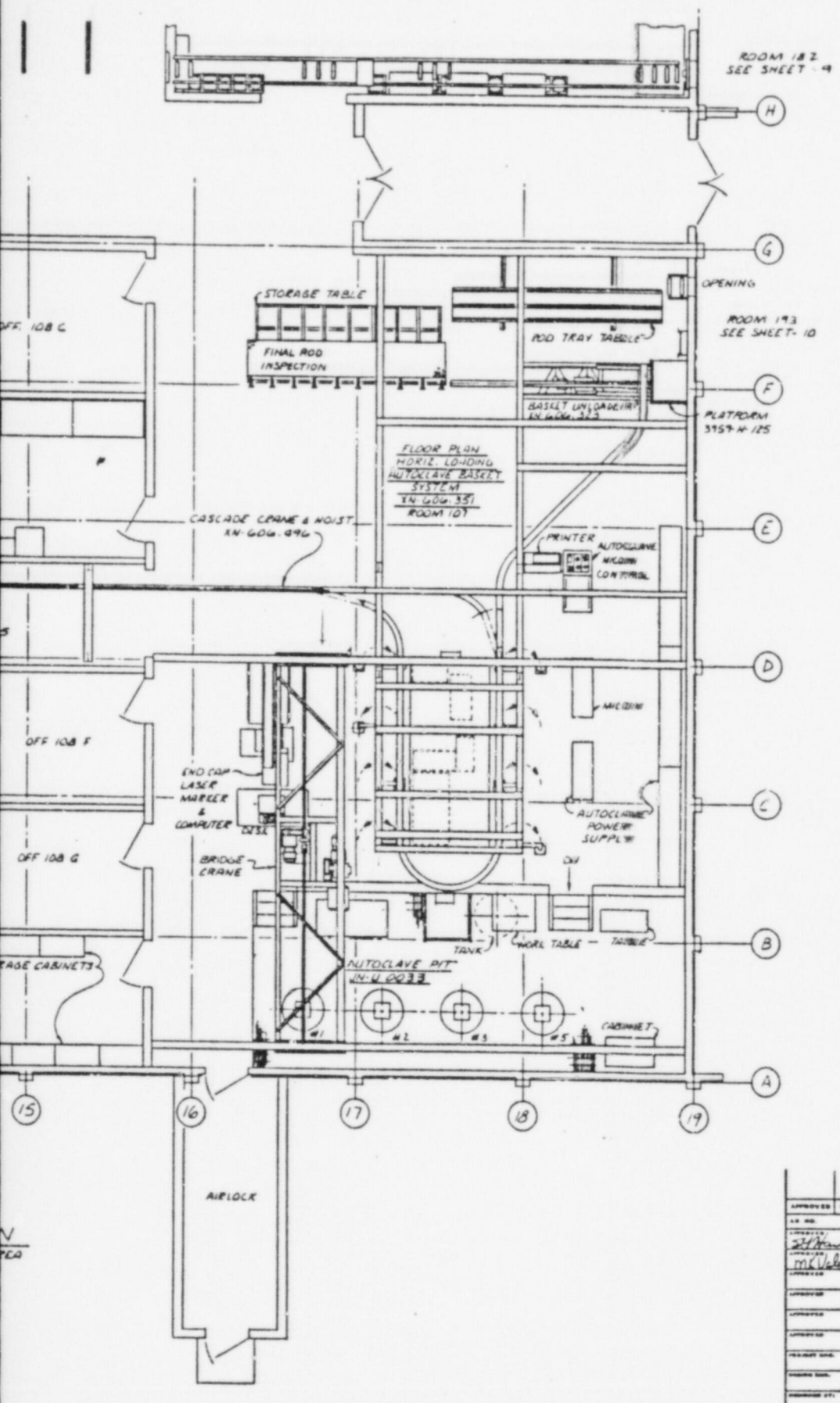

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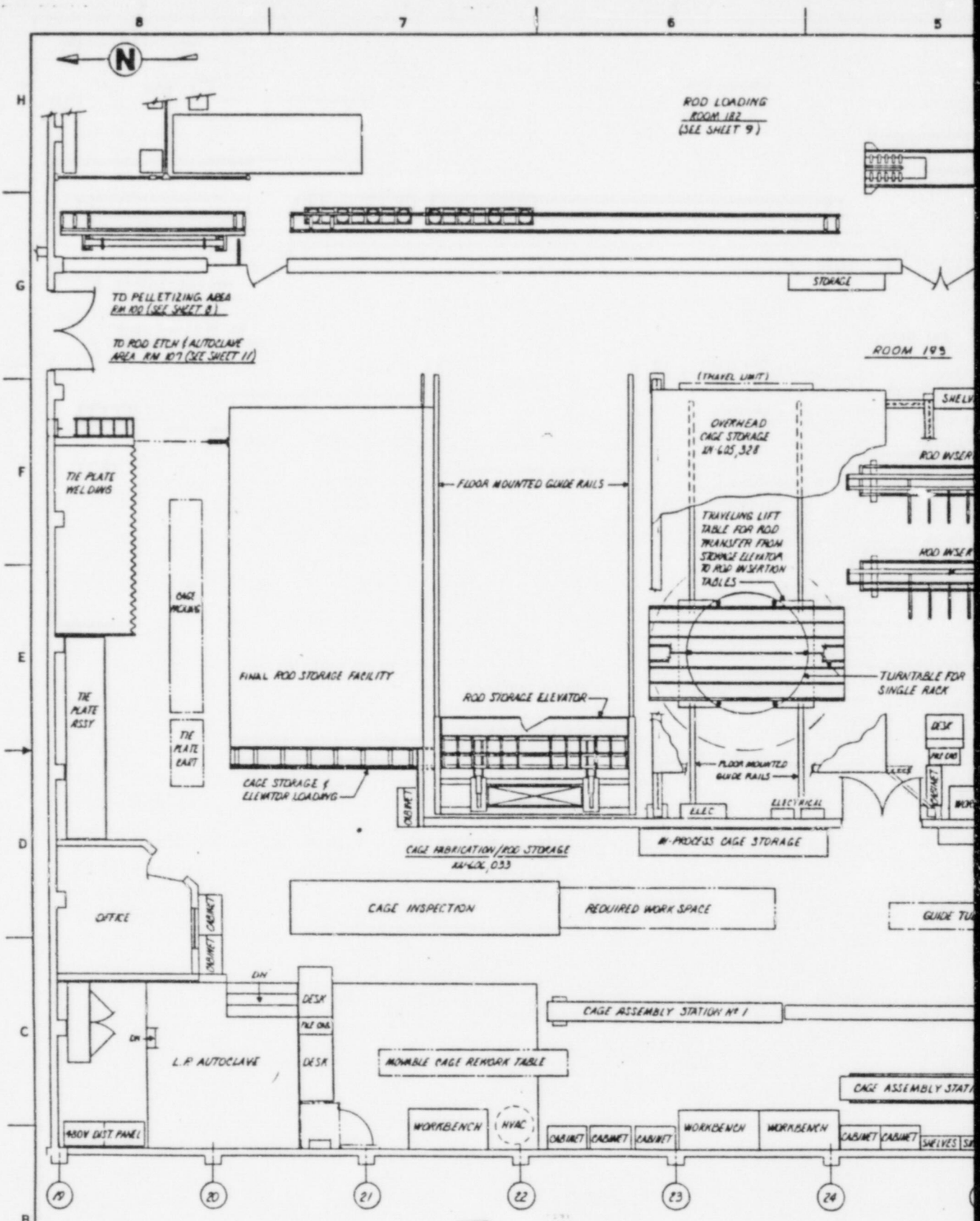
FIGURE II-10.12

EXXON NUCLEAR COMPANY, INC.

PLANT
EQUIPMENT LAYOUT
UO_2 BLDG

XN-607,590 | 11 | 27 | 0



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Aperture Card

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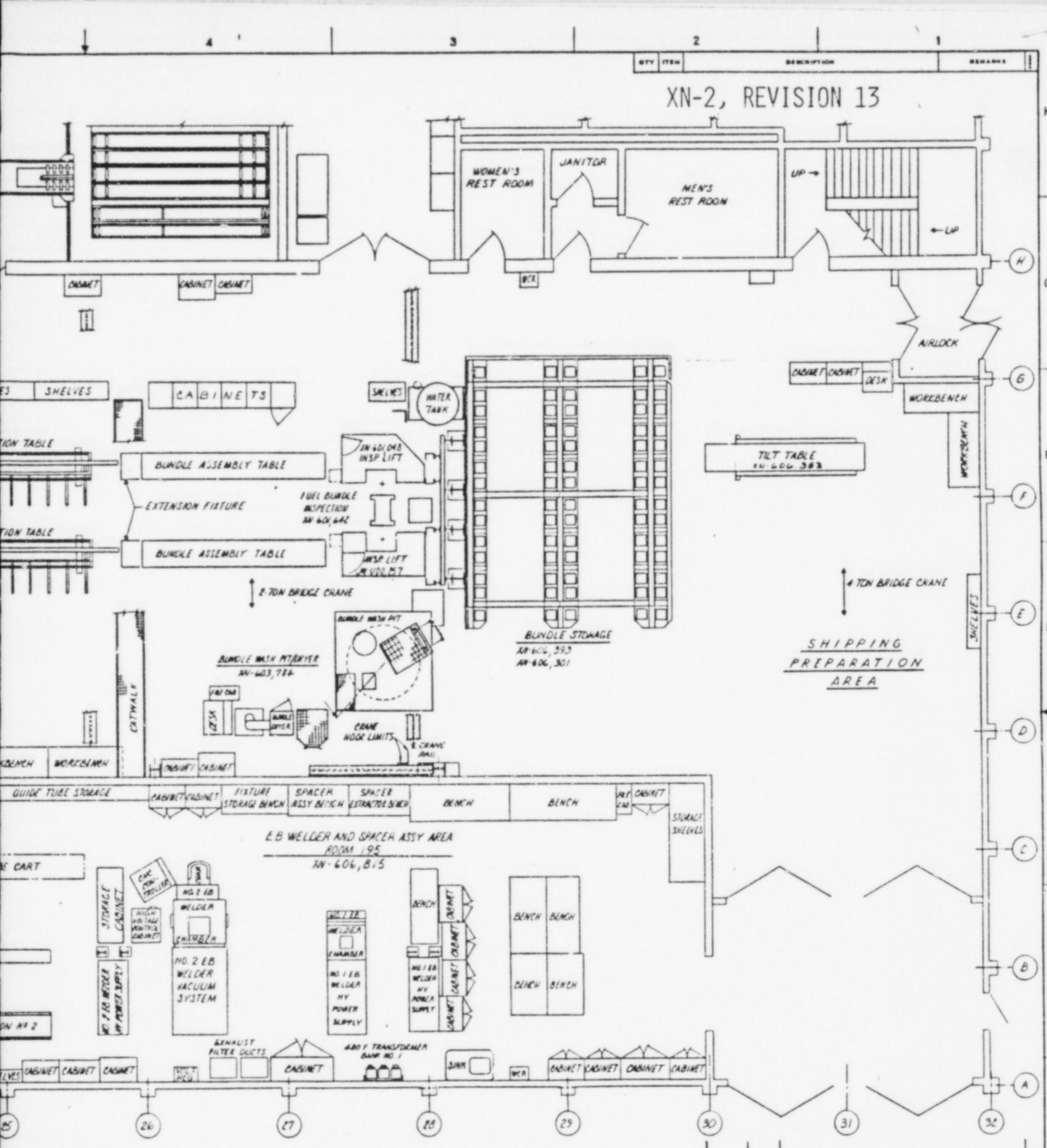


FLOOR PLAN

MBLY PACKAGING &
E FABRICATION

FIGURE II-10.13

8609260255-14

APPROVED	BRANCH	REVISION DESCRIPTION	REV

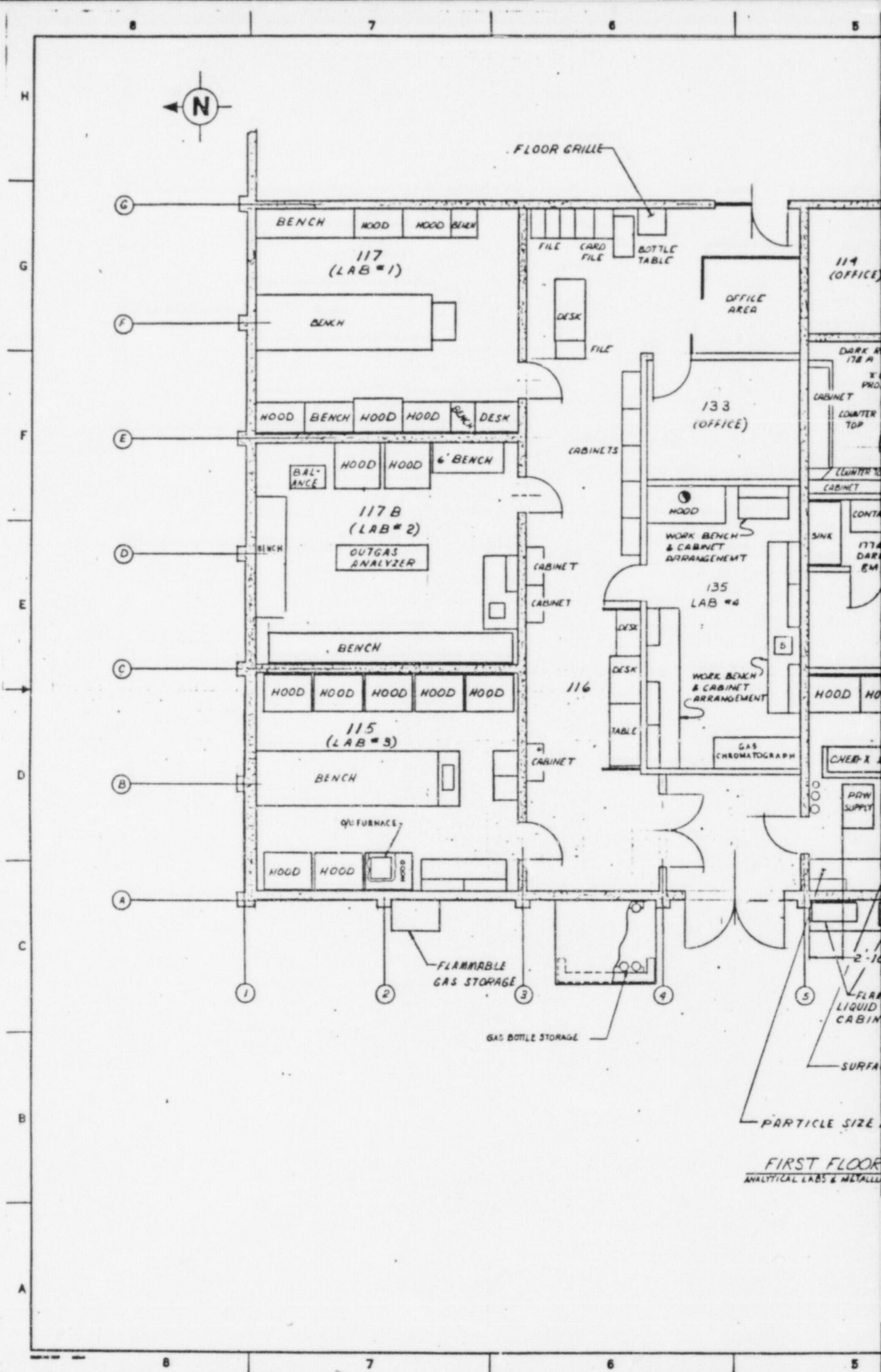
EXXON NUCLEAR COMPANY, INC.
RICHLAND, WASHINGTON

PLANT EQUIPMENT LAYOUT UO_2 BLDG

XN-607,590

10 27 0

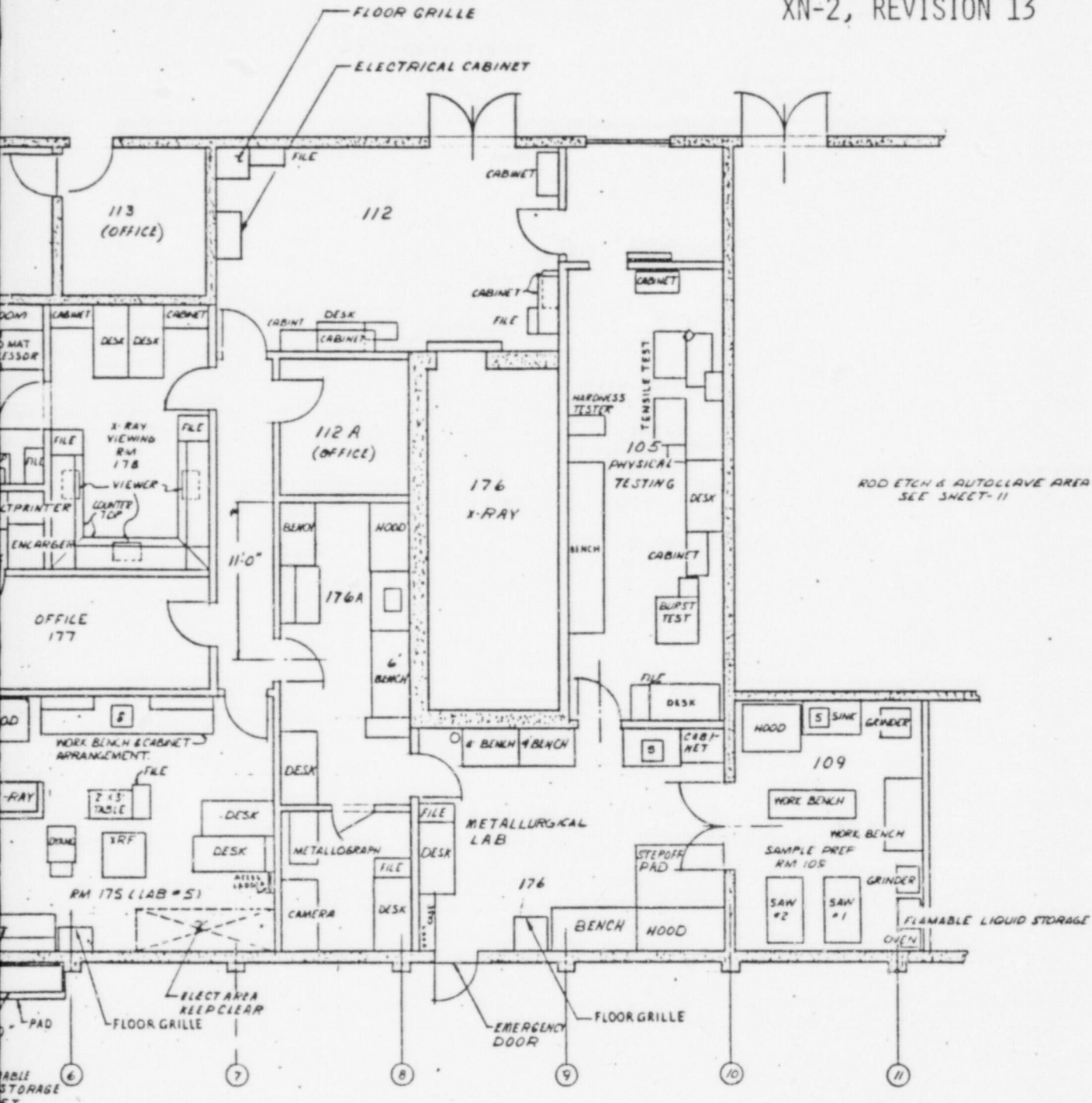
1/4" = 1'-0"



FIRST FLOOR

ANALYTICAL LABS & METALLU

XN-2, REVISION 13



8609260255-15

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Also Available On Aperture Card

FIGURE II-10.14

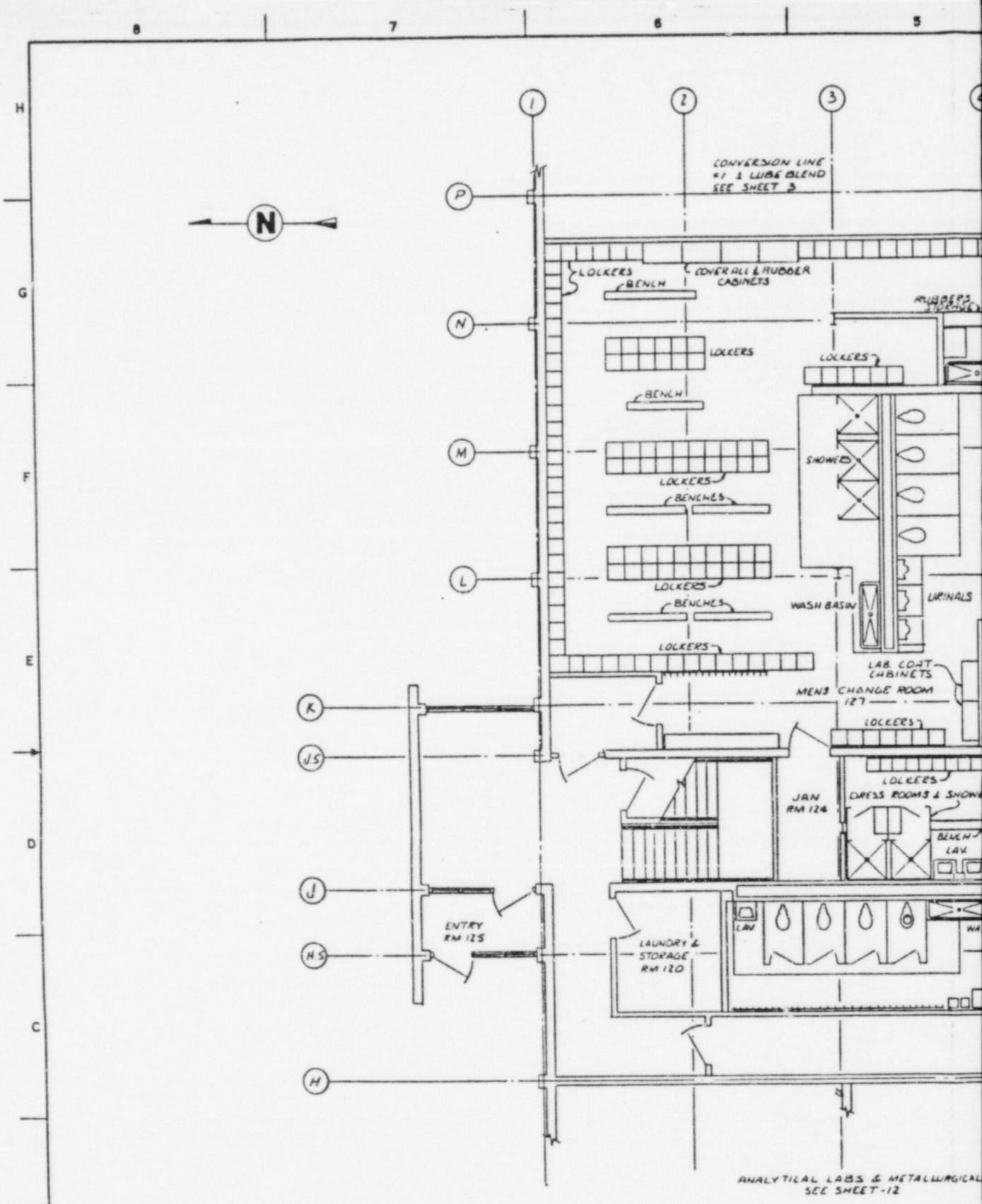
3959-MBB		ANALYTICAL LAB MODIF (FLOOR PLAN
XN-604.857		ANALYTICAL LAB PIPING SERVICES
XN-607.518		EQUIPMENT LAYOUT AND UTILITIES RM 109, 175, 176, 176A, 177A
XN-607.525		EQUIPMENT LAYOUT AND UTILITIES
VITRO 3959-A-6		UO_2 FACILITY 1ST FLOOR PLAN
DWG. NO.	REV	REFERENCE DRAWING TITLE

EXXON NUCLEAR COMPANY, Inc.
RICHLAND, WASHINGTON 99352

PLANT EQUIPMENT LAYOUT UO_2 BLDG

DRAWN BY: BISHOP/FORESMAN
SCALE: 1/4" = 1'0"

XN-607.590 | 12 | 27 | 0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J.S
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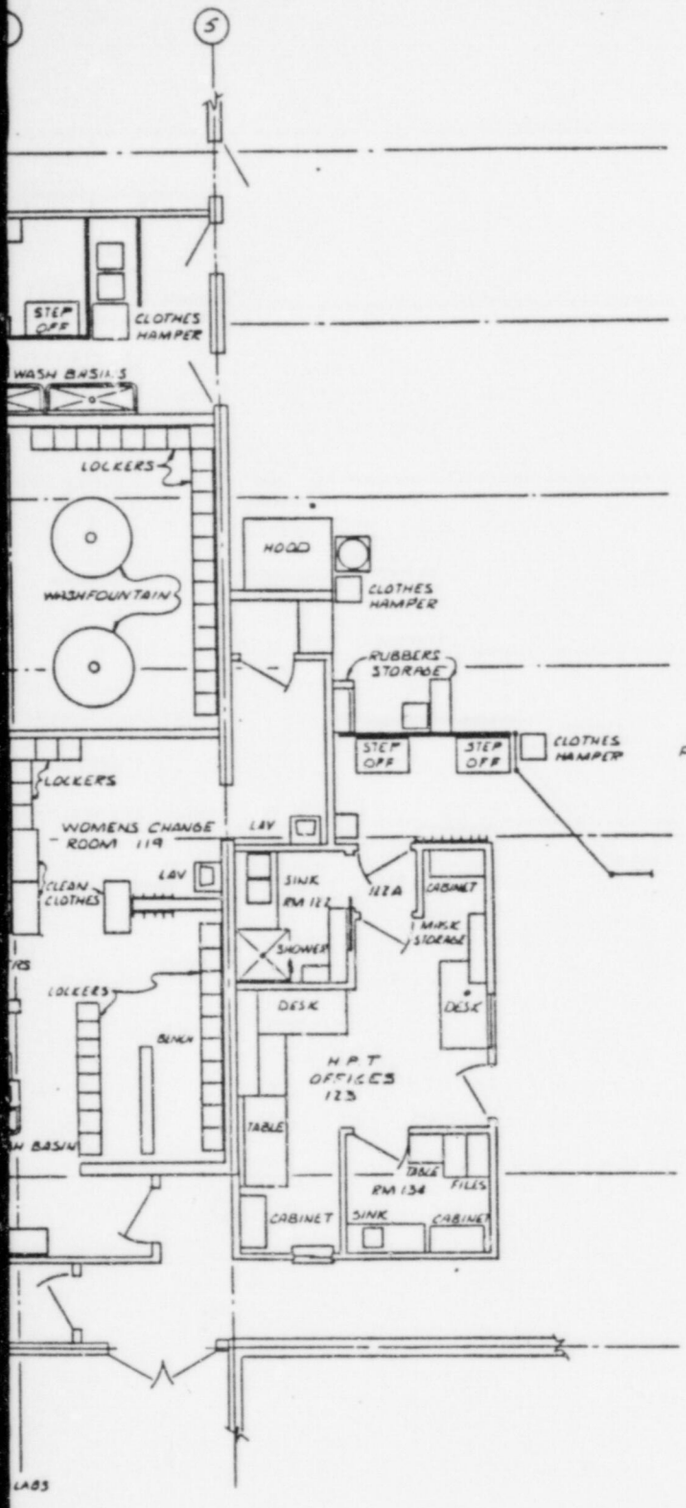
H
N
CONVERSION LINE
#1 1 LUBE BLEND
SEE SHEET 3
LOCKERS
BENCH
COVER ALL & RUBBER
CABINETS
LOCKERS
BENCH
LOCKERS
SHOWERS
LOCKERS
BENCHES
LOCKERS
BENCHES
LOCKERS
WASH BASIN
URINALS
LAB. COAT
CABINETS
MEN'S CHANGE ROOM
127
LOCKERS
LOCKERS
JAN
RM 124
DRESS ROOMS & SHOWE
BENCH
LAV.
LAV
ENTRY
RM 125
LAUNDRY &
STORAGE
RM 120
ANALYTICAL LABS & METALLURGICAL
SEE SHEET-12
FIRST FL
MEN'S . WOMEN
& H.R.T OFFICE

XN-2, REVISION 13



PELLETIZING AREA
ROOM 100
SEE SHEET - B

OOR PL 'N
CHANGE ROOM

TI
APERTURE
CARD

Also Available On
Aperture Card

8609260255-16

FIGURE II-10.15

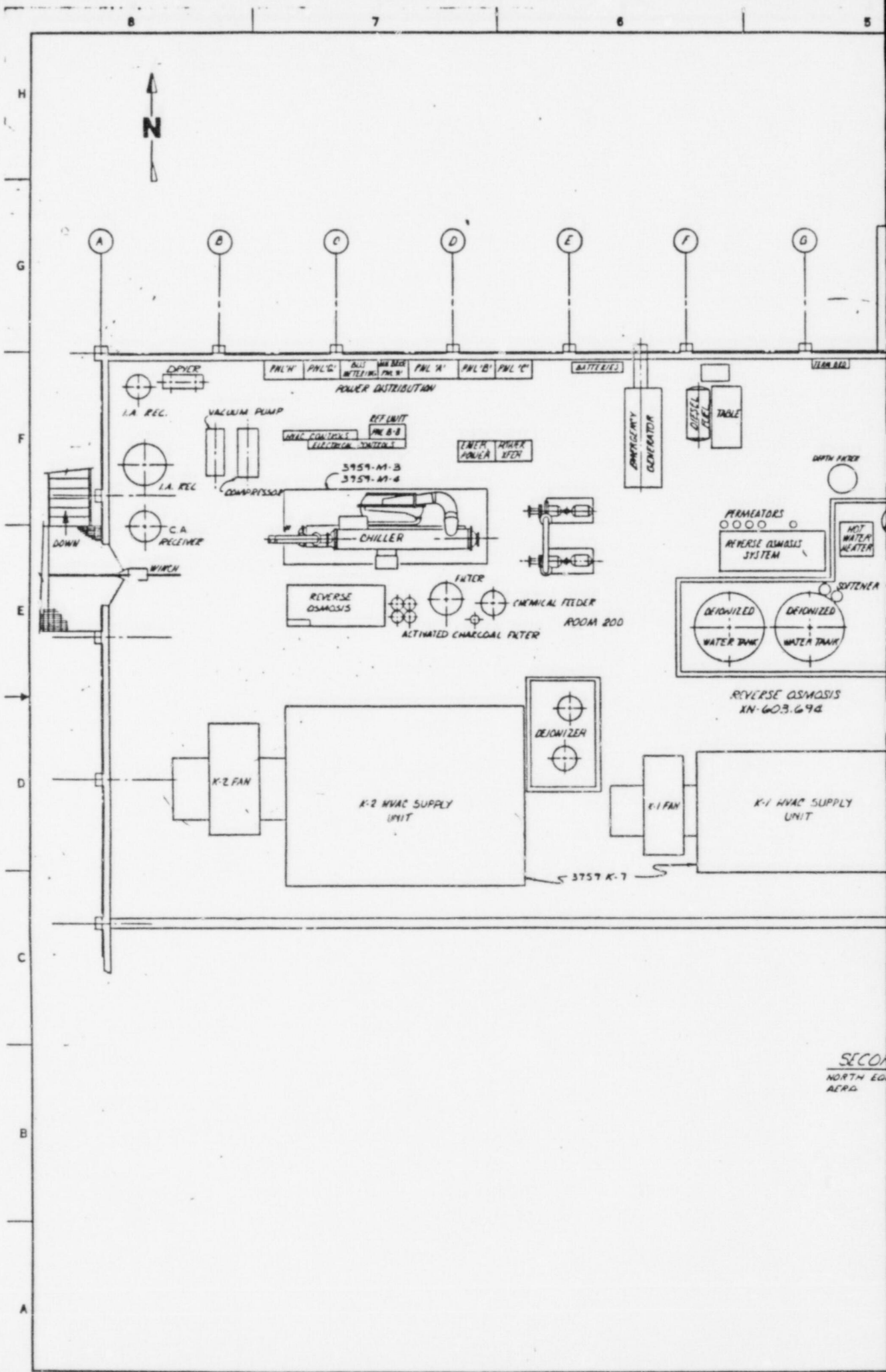
EXXON NUCLEAR COMPANY, INC.

PLANT
EQUIPMENT LAYOUT
UO2 BLDG

XN-607,590

DRAWN BISHOP 12-11-85

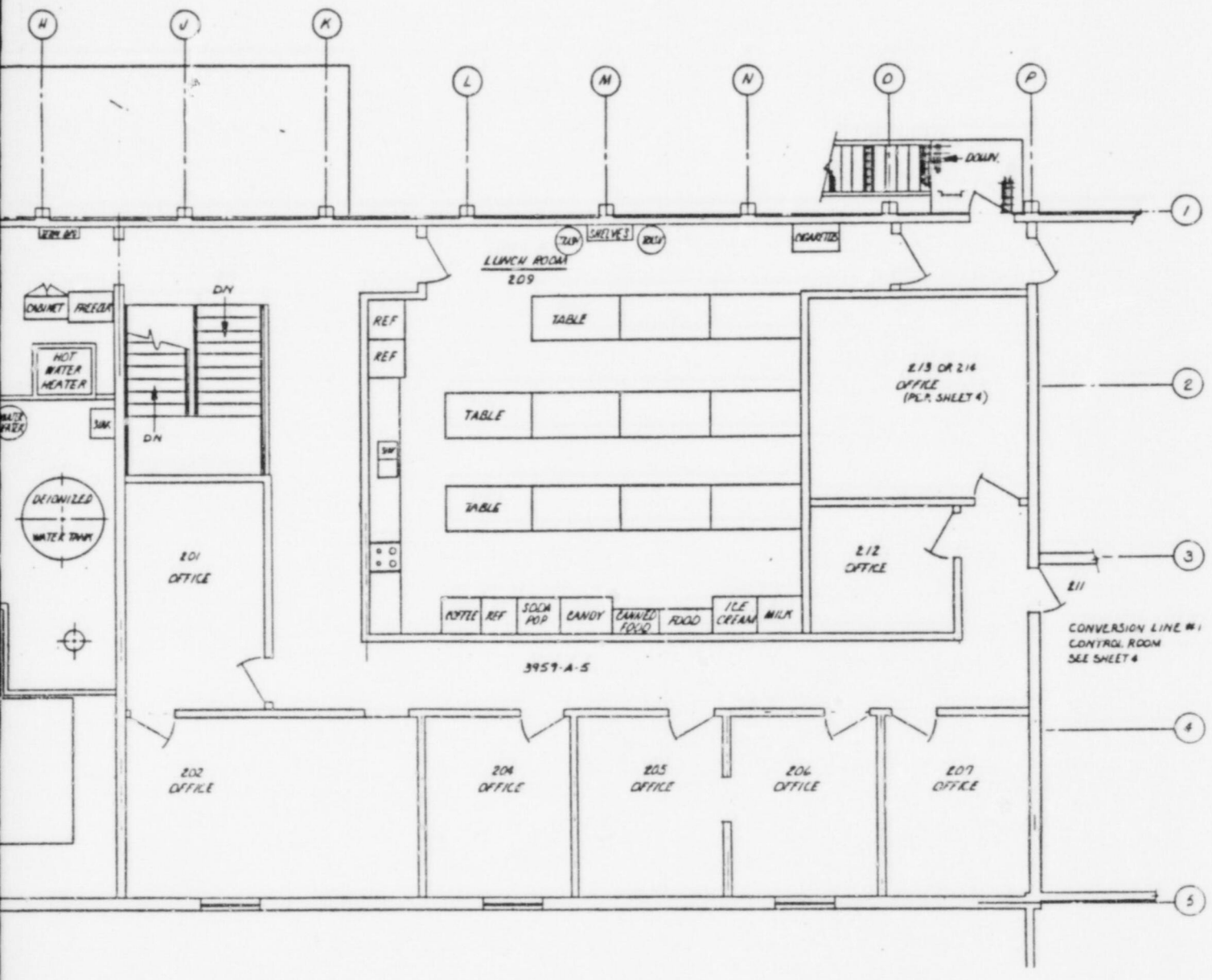
1:1:0"



SECO

NORTH EG
AERO

XN-2, REVISION 13



...0 FLOOR PLAN
...IPMENT ROOM & OFFICE

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8609260255-17

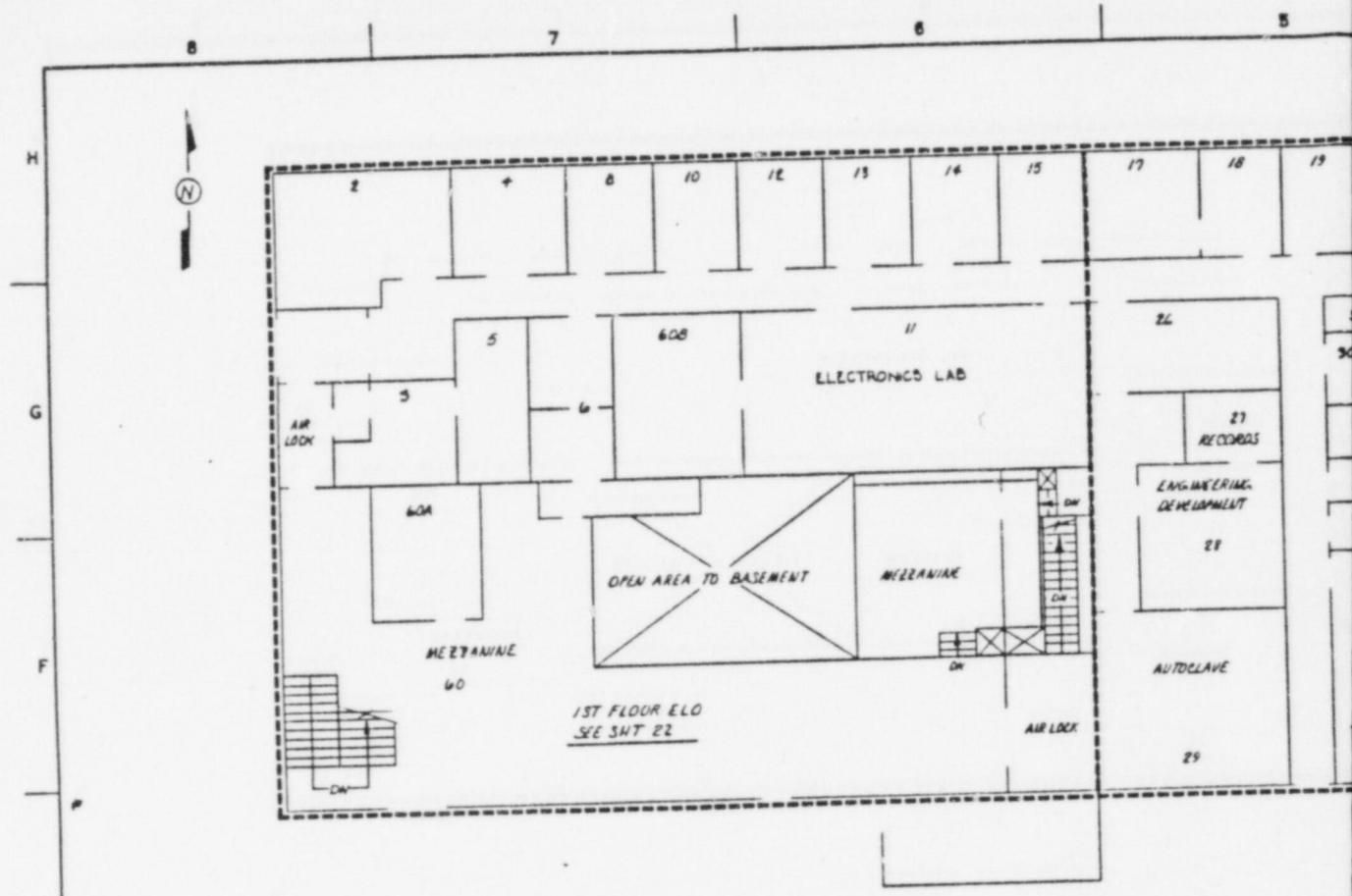
FIGURE II-10.16

EXXON NUCLEAR COMPANY, INC.
RICHLAND, WASHINGTON

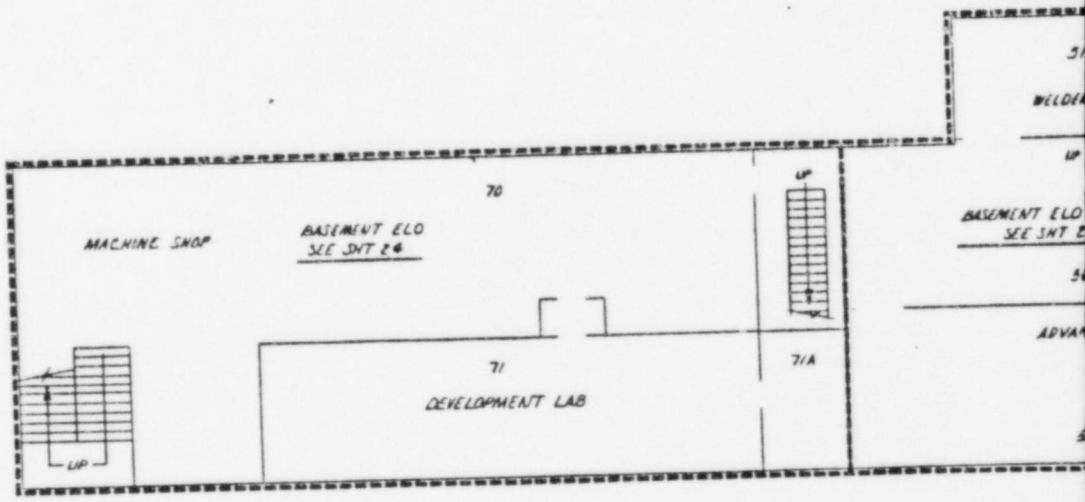
PLANT EQUIPMENT LAYOUT UO2 BLDG.

XN-607,590

15 | 77 | 0

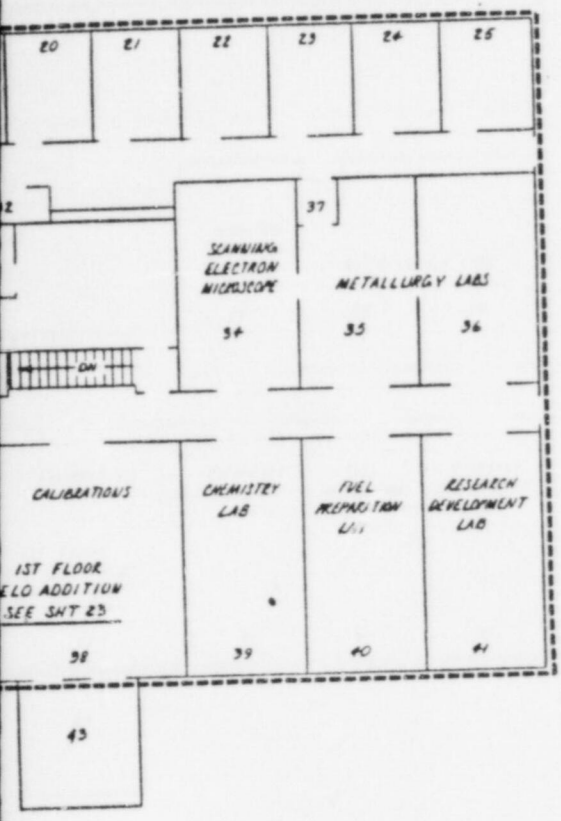


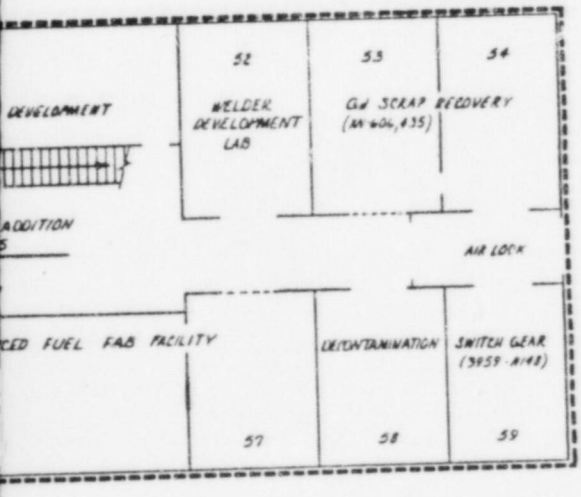
1ST FLOOR - ELO BUILDING



BASEMENT - ELO BUILDING

XN-2, REVISION 13





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CARD

Also Available On
Aperture Card

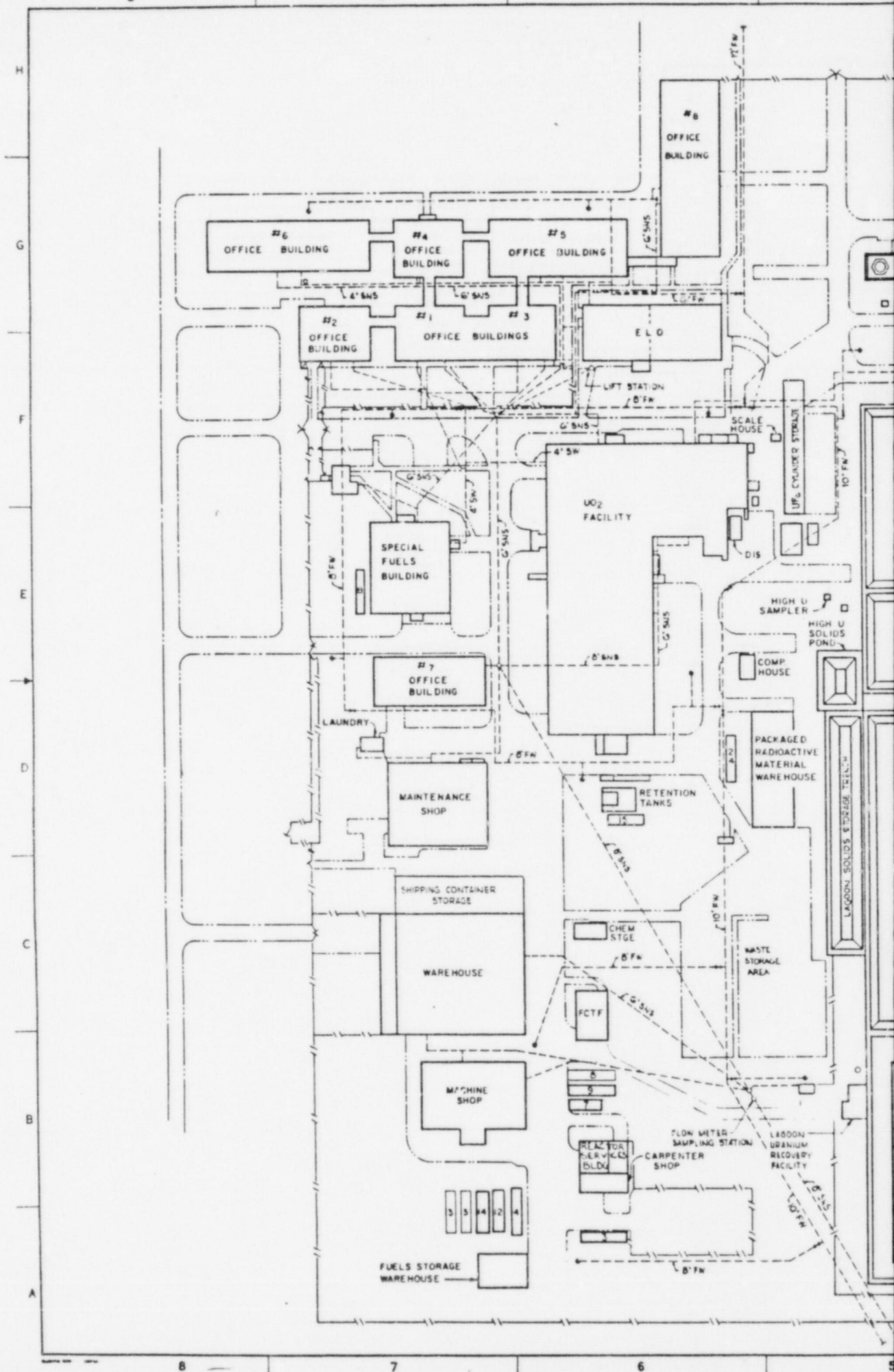
8609260255-18

FIGURE II-10.17

EXXON NUCLEAR COMPANY, INC.

PLANT EQUIPMENT
LAYOUT
ELO BUILDING

XN-607, 590 | 21 | 0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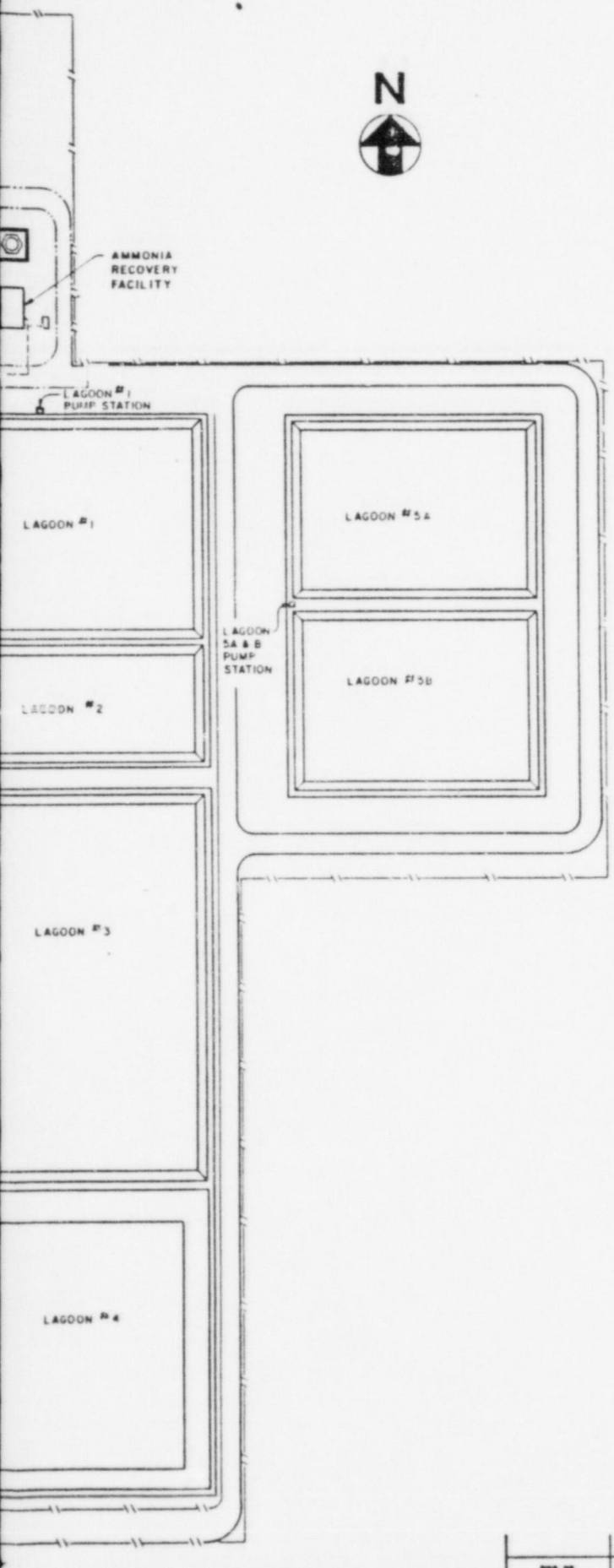
#8 OFFICE BUILDING
#6 OFFICE BUILDING
#4 OFFICE BUILDING
#5 OFFICE BUILDING
#2 OFFICE BUILDING
#1 OFFICE BUILDINGS
#3
E L O
LIFT STATION
SCALE HOUSE
UF6 CYLINDER STORAGE
UO2 FACILITY
DIS
SPECIAL FUELS BUILDING
HIGH U SAMPLER
HIGH U SOLIDS POND
COMP. HOUSE
#7 OFFICE BUILDING
LAUNDRY
MAINTENANCE SHOP
PACKAGED RADIOACTIVE MATERIAL WAREHOUSE
RETENTION TANKS
LAGOON SOLIDS STORAGE
SHIPPING CONTAINER STORAGE
WAREHOUSE
CHEM STGE
WASTE STORAGE AREA
FCTF
MACHINE SHOP
REACTOR SERVICES BLDG
CARPENTER SHOP
FLOW METER SAMPLING STATION
LAGOON URANIUM RECOVERY FACILITY
FUELS STORAGE WAREHOUSE

XN-2, REVISION 13



TI APERTURE CARD

Also Available On Aperture Card

8609260255-19

FIGURE II-10.18

EXXON NUCLEAR COMPANY, Inc.

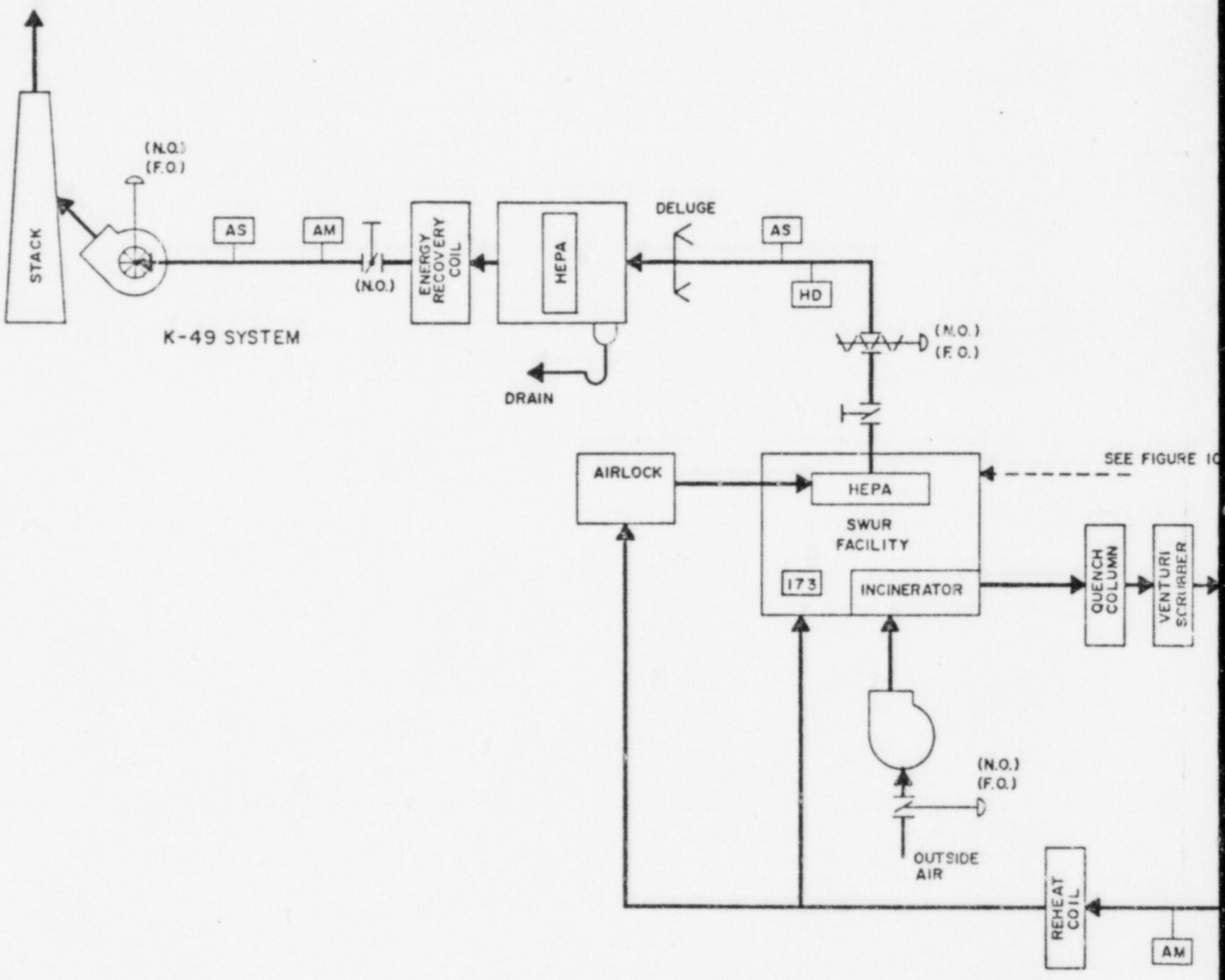
EXXON NUCLEAR COMPANY
SITE PLAN
RICHLAND, WASH.

XN-607,676

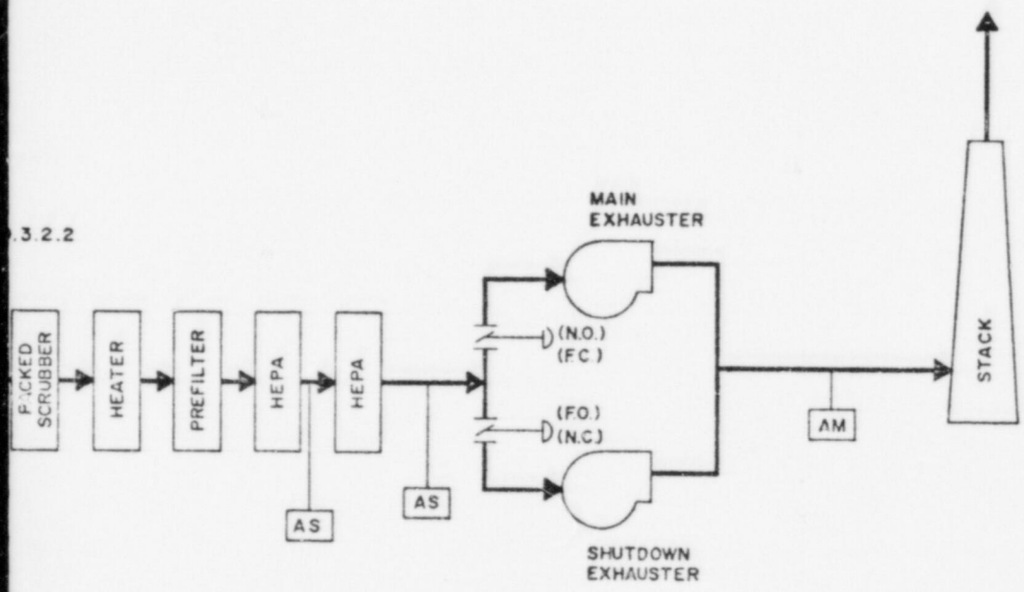
J. HELTON 4/14/86

COOK 4-16-86

1" = 60'

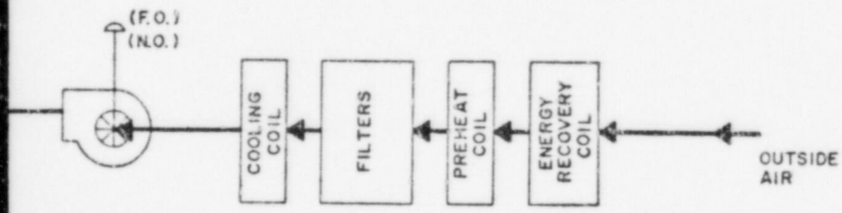


SIMPLIFIED SCHEMATIC HVAC SYSTEM -



TI
APERTURE
CARD

Also Available On
Aperture Card



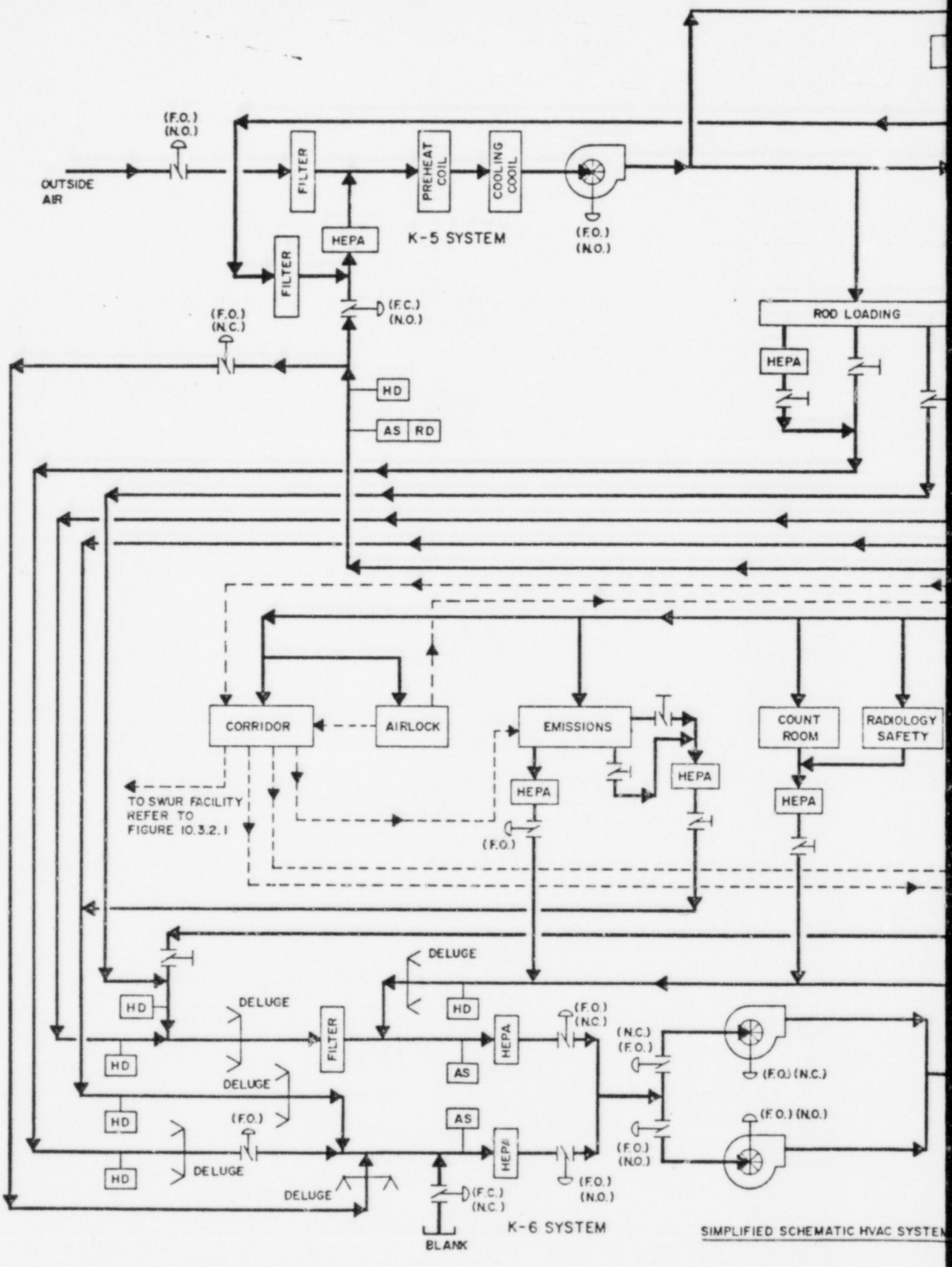
K-48 SYSTEM

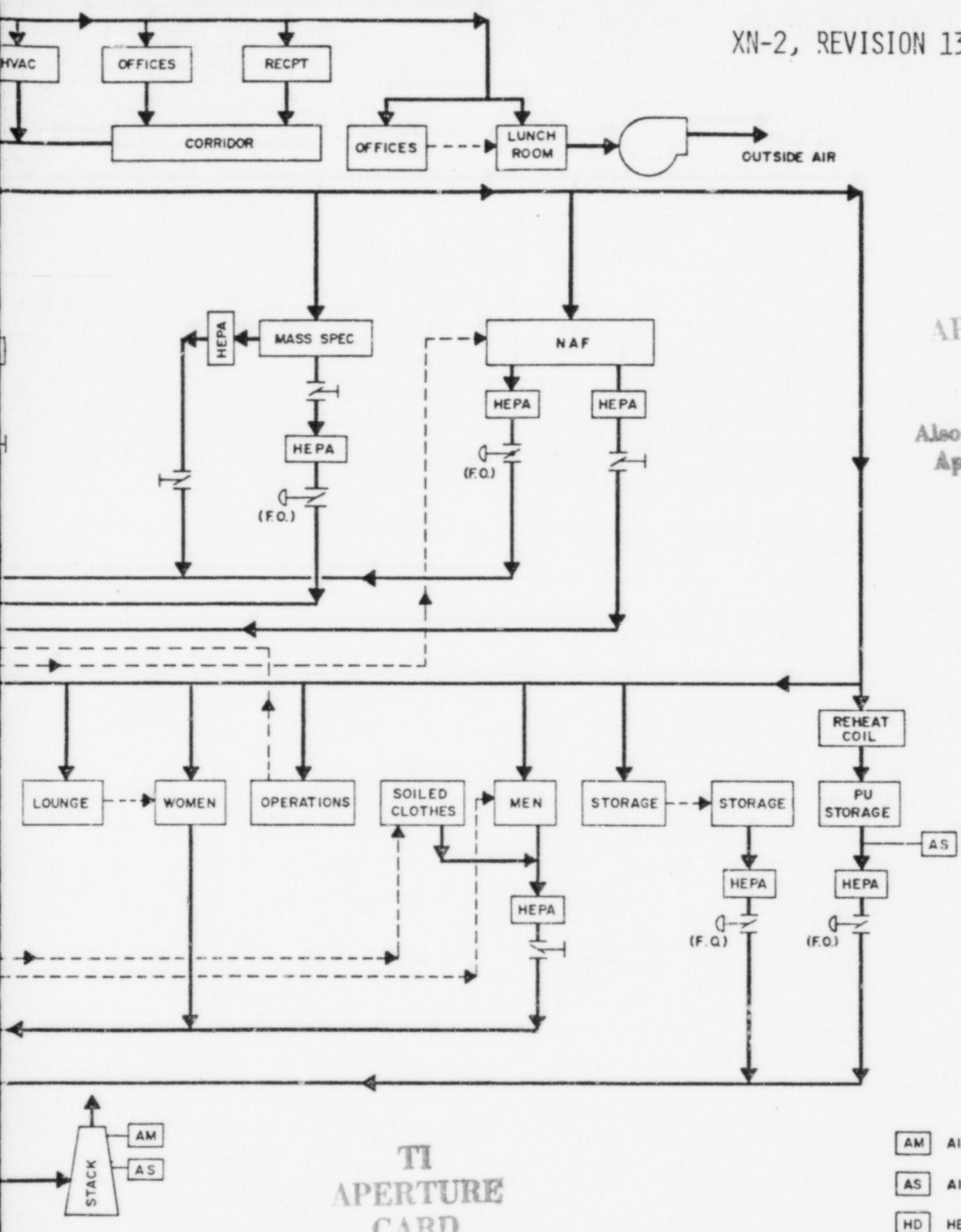
S.F. BUILDING SWUR FACILITY

AM AIR FLOW MONITOR
AS AIR SAMPLER
HD HEAT DETECTOR
(F.C.) FAIL CLOSED
(F.O.) FAIL OPEN
(N.O.) NORMALLY OPEN
(N.C.) NORMALLY CLOSED

FIGURE II-10.19

8609260255-20


OUTSIDE AIR
(F.O.) (N.O.)
FILTER
PREHEAT COIL
COOLING COOIL
(F.O.) (N.O.)
HEPA
K-5 SYSTEM
FILTER
(F.O.) (N.C.)
(F.C.) (N.O.)
ROD LOADING
HEPA
HD
AS
RD
CORRIDOR
AIRLOCK
EMISSIONS
COUNT ROOM
RADIOLOGY SAFETY
HEPA
HEPA
HEPA
TO SWUR FACILITY REFER TO FIGURE 10.3.2.1
(F.O.)
DELUGE
HD
DELUGE
FILTER
HD
HEPA
(F.O.) (N.C.)
(N.C.) (F.O.)
(F.O.) (N.C.)
HD
AS
DELUGE
(F.O.)
AS
(F.O.) (N.O.)
HD
DELUGE
HEPA
(F.O.) (N.O.)
DELUGE
(F.C.) (N.C.)
BLANK
K-6 SYSTEM
SIMPLIFIED SCHEMATIC HVAC SYSTEM



TI APERTURE CARD

Also Available On Aperture Card

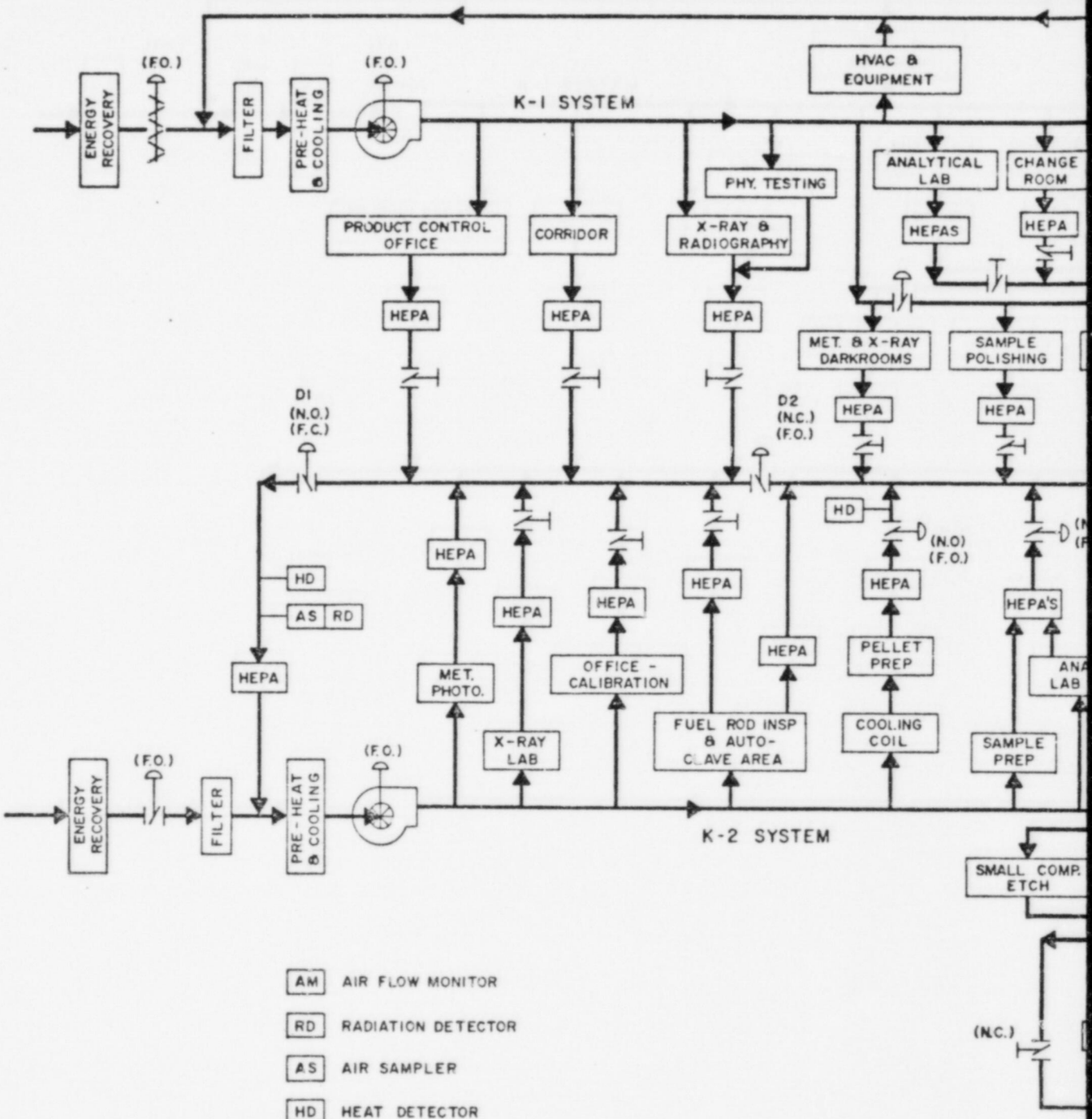
AM AIR FLOW MONITOR
AS AIR SAMPLER
HD HEAT DETECTOR
RD RADIATION DETECTOR
(F.O.) FAIL OPEN
(F.C.) FAIL CLOSED
(N.O.) NORMALLY OPEN
(N.C.) NORMALLY CLOSED

TI APERTURE CARD

Also Available On Aperture Card

FIGURE II-10.20

8609260255-21



AM AIR FLOW MONITOR

RD RADIATION DETECTOR

AS AIR SAMPLER

HD HEAT DETECTOR

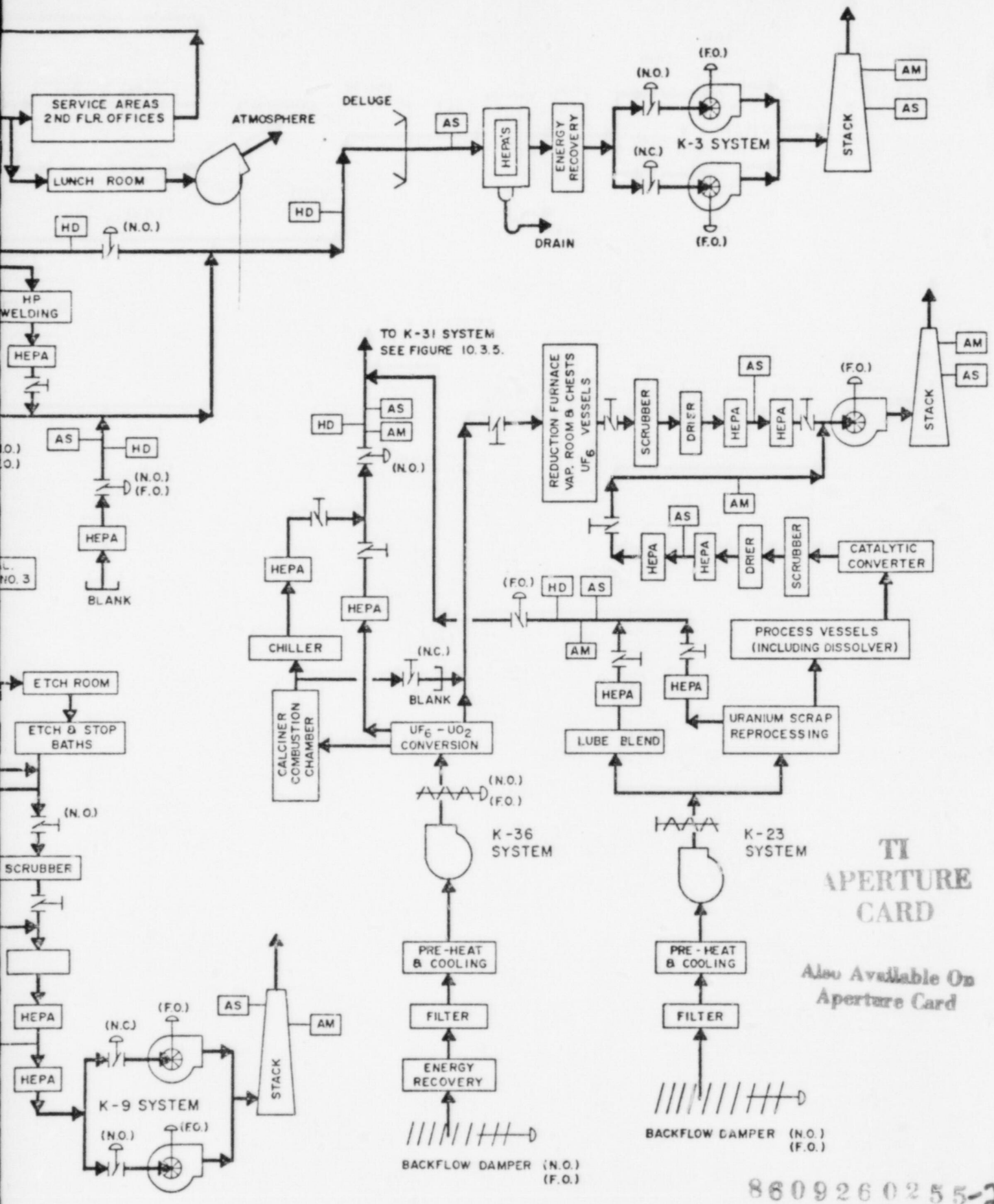
(N.O.) - NORMALLY OPEN

(N.C.) NORMALLY CLOSED

(F.O.) FAIL OPEN

(F.C.) FAIL CLOSED

SIMPLIFIED SCHEMATIC HVAC SYSTEM - ORIGINAL UO_2 BUILDING

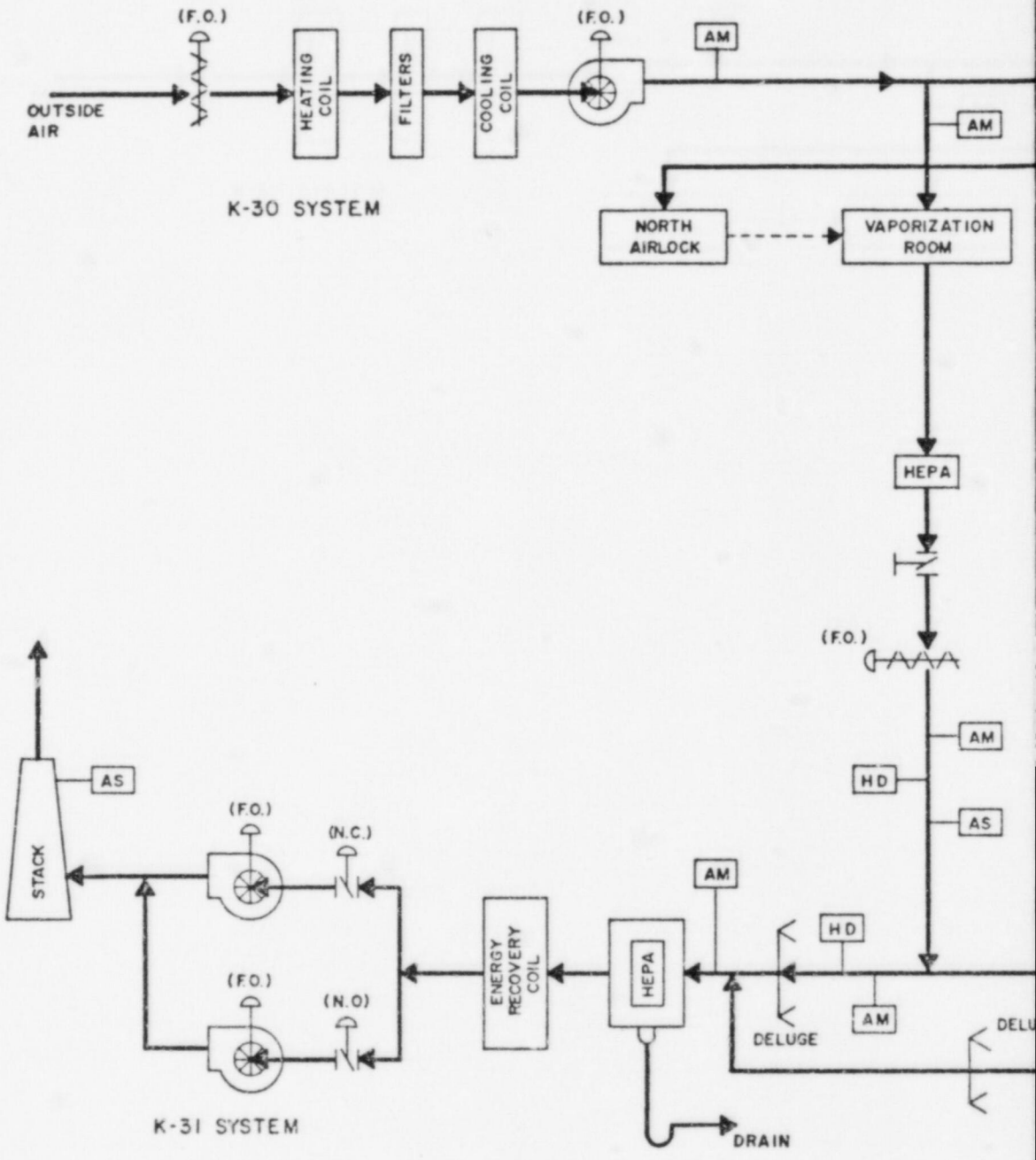


TI APERTURE CARD

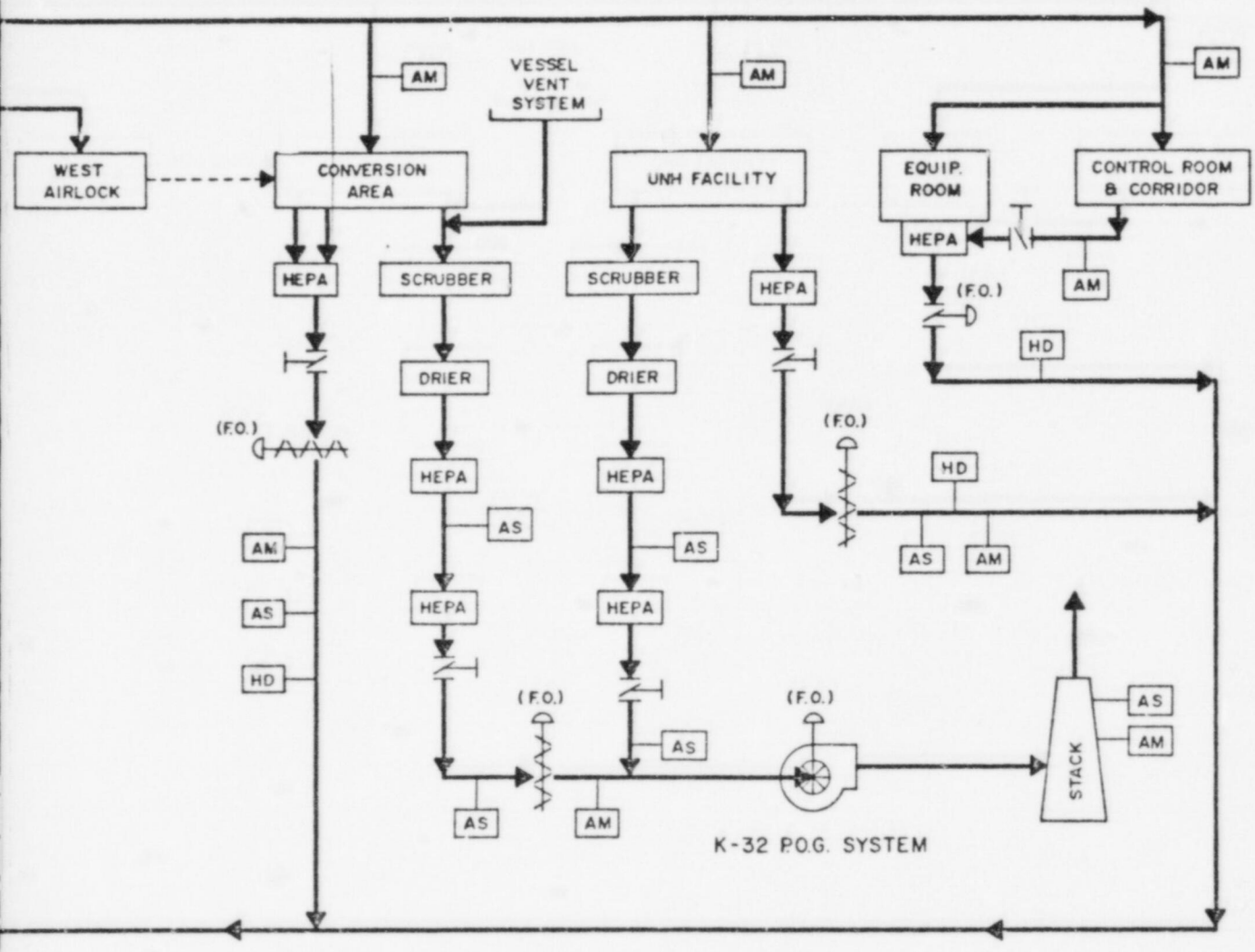
Also Available On Aperture Card

8609260255-22

FIGURE II-10.21



SIMPLIFIED SCHEMATIC HVAC SYSTEM - UO_2



GE

FROM K-23 & K-26 SYSTEM
SEE FIGURE 10.3.3

BUILDING LINE II COVERSION AREA

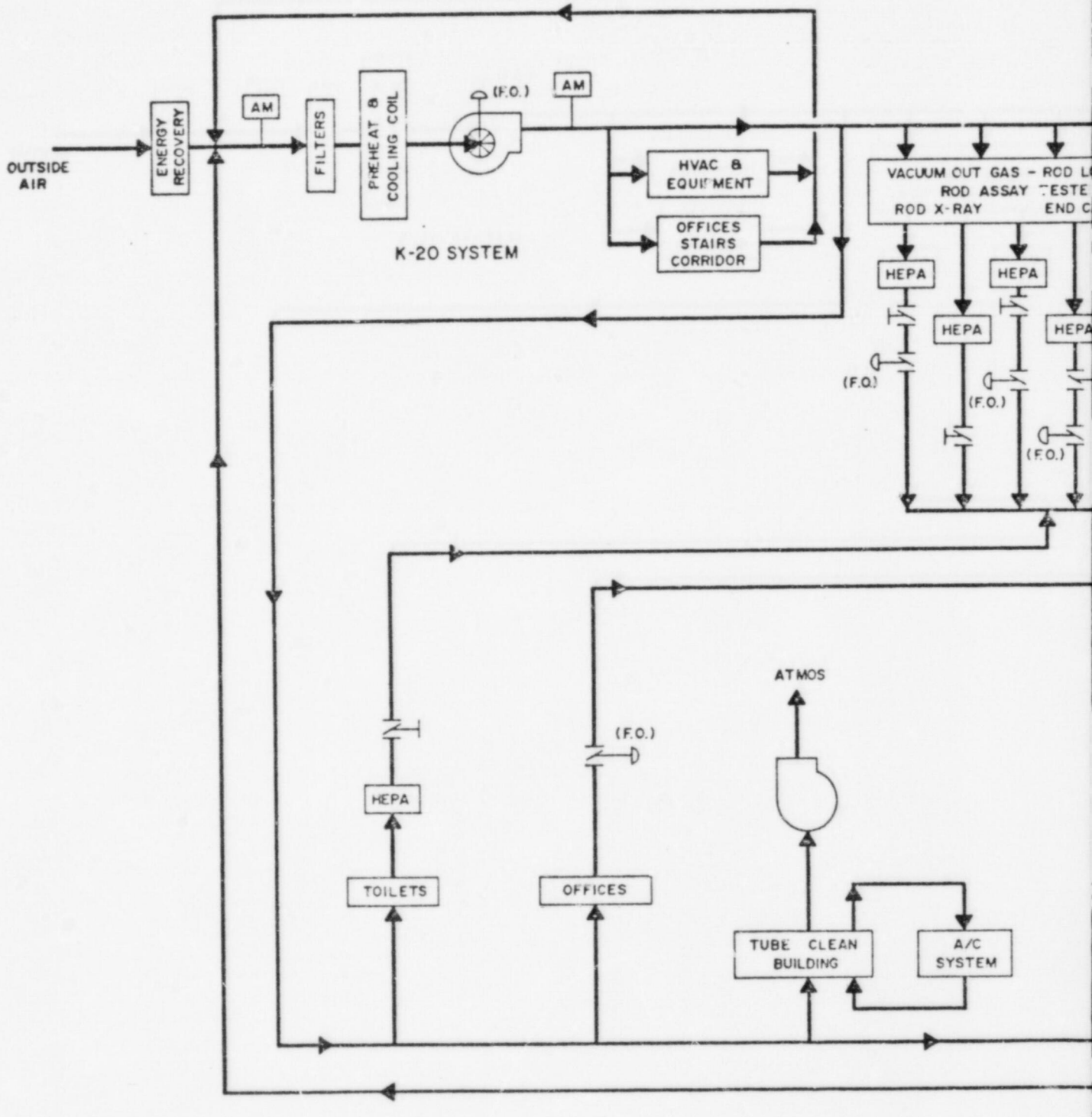
AM AIR FLOW MONITOR
AS AIR SAMPLER
HD HEAT DETECTOR
(F.O.) FAIL OPEN
(N.O.) NORMALLY OPEN
(N.C.) NORMALLY CLOSED

TI APERTURE CARD

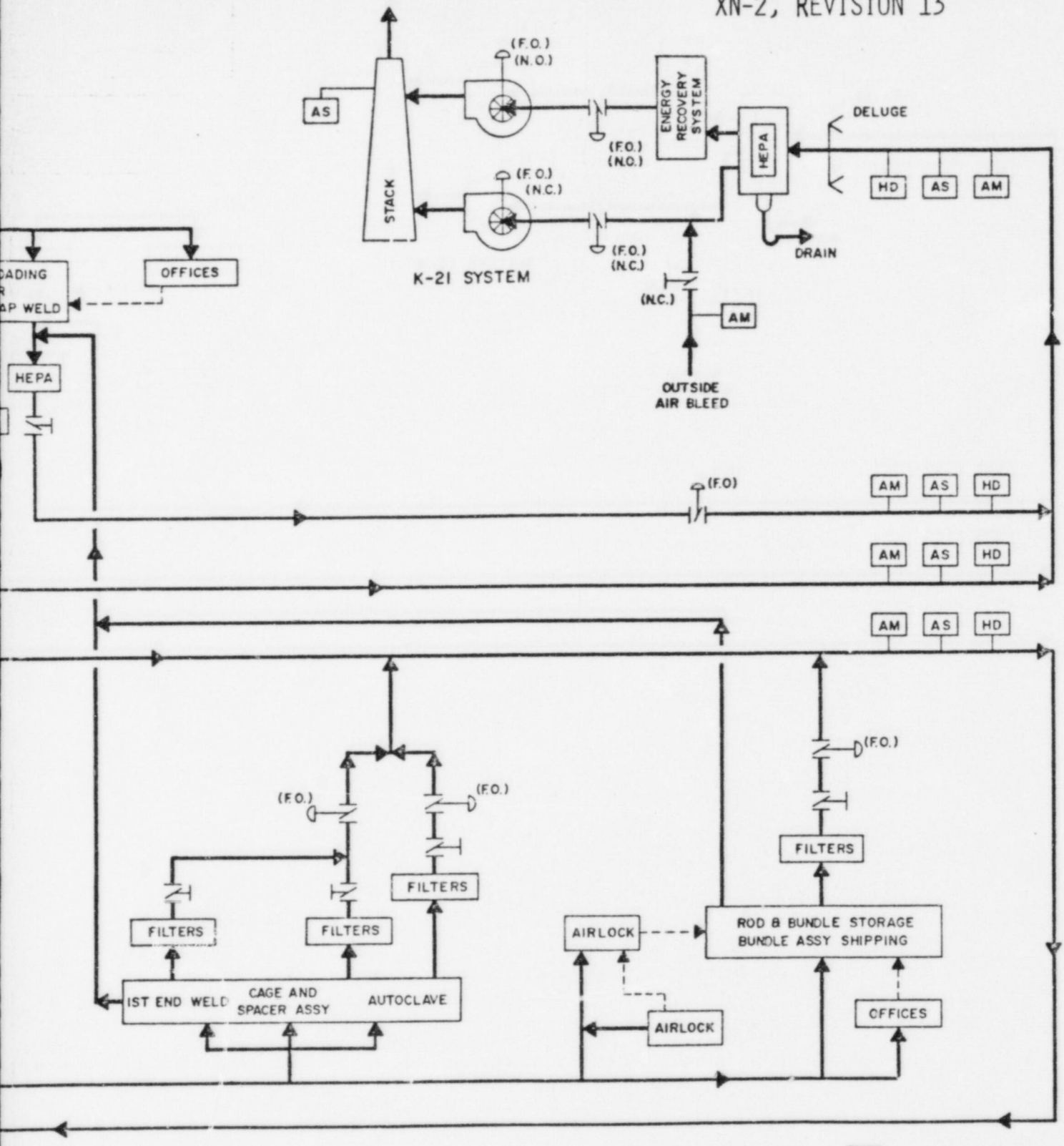
Also Available On Aperture Card

FIGURE II-10.22

8609260255-23



SIMPLIFIED SCHEMATIC HVAC S



AM AIR FLOW MONITOR

AS AIR SAMPLER

HD HEAT DETECTOR

(F.O.) FAIL OPEN

(N.O.) NORMALLY OPEN

(N.C.) NORMALLY CLOSED

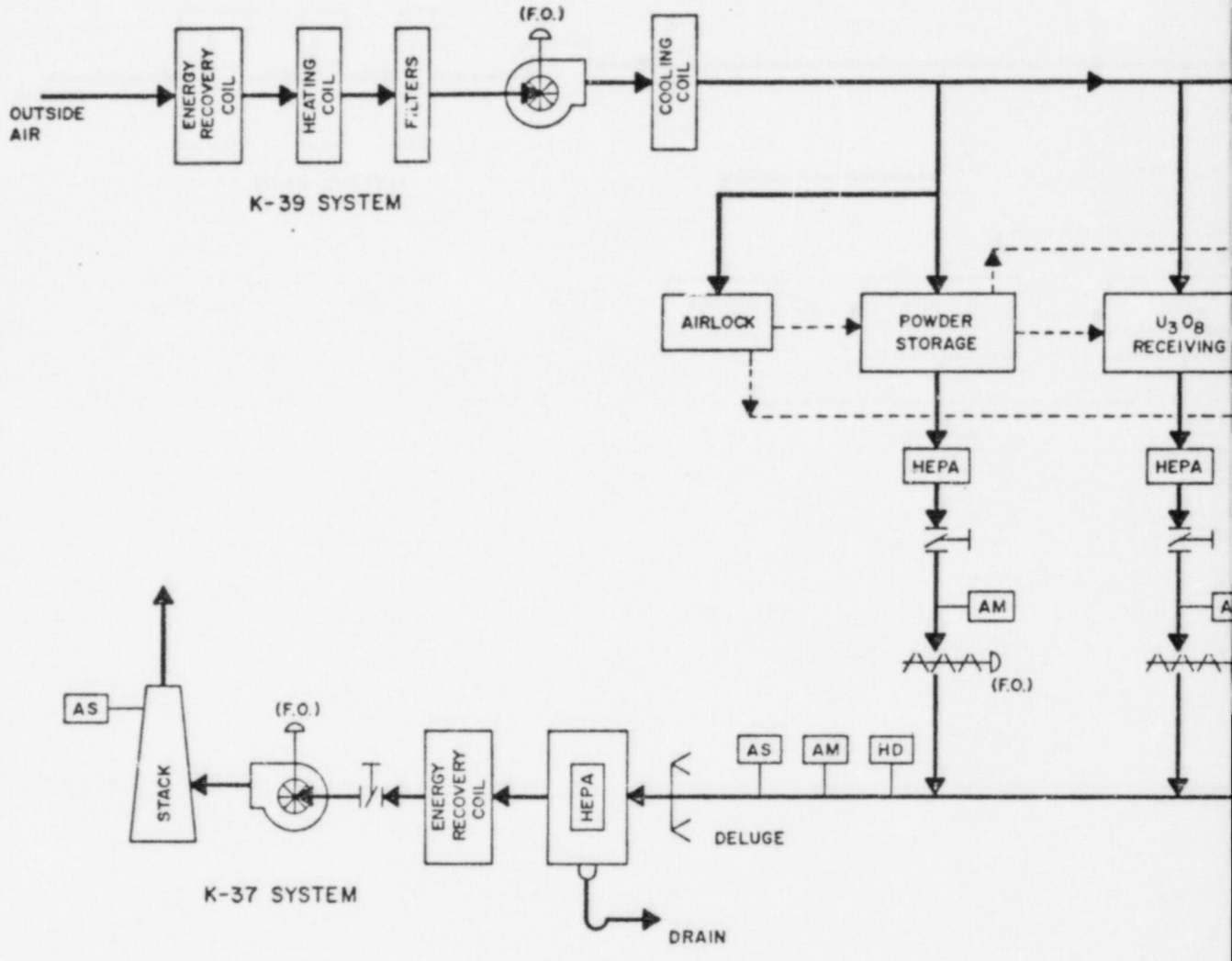
YSTEM - MAIN (SOUTH) ADDITION

FIGURE II-10.23

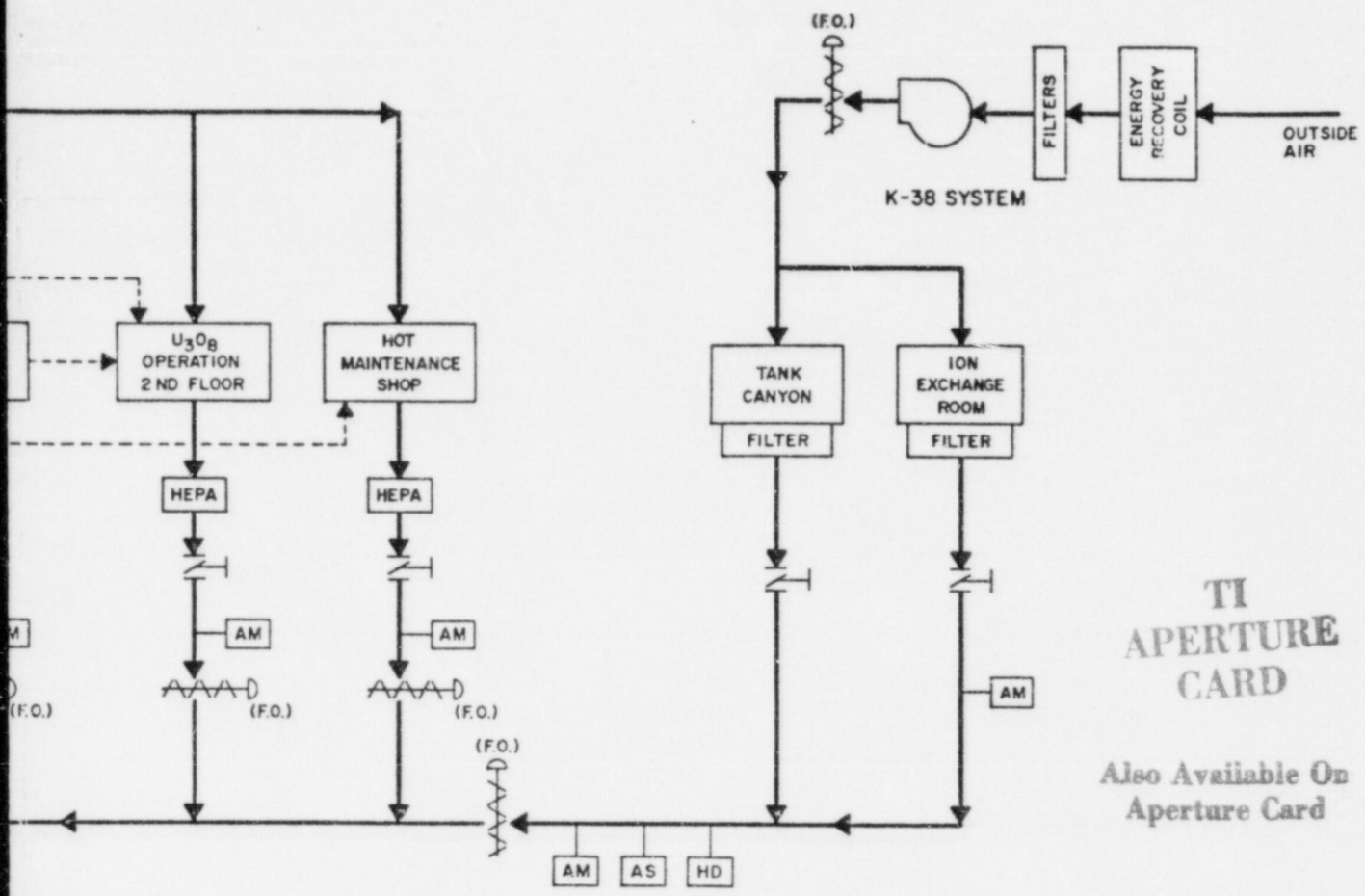
TI APERTURE CARD

Also Available On Aperture Card

8609260255-24



SIMPLIFIED SCHEMATIC HVAC SYSTE



TI APERTURE CARD

Also Available On Aperture Card

AM AIR FLOW MONITOR

AS AIR SAMPLER

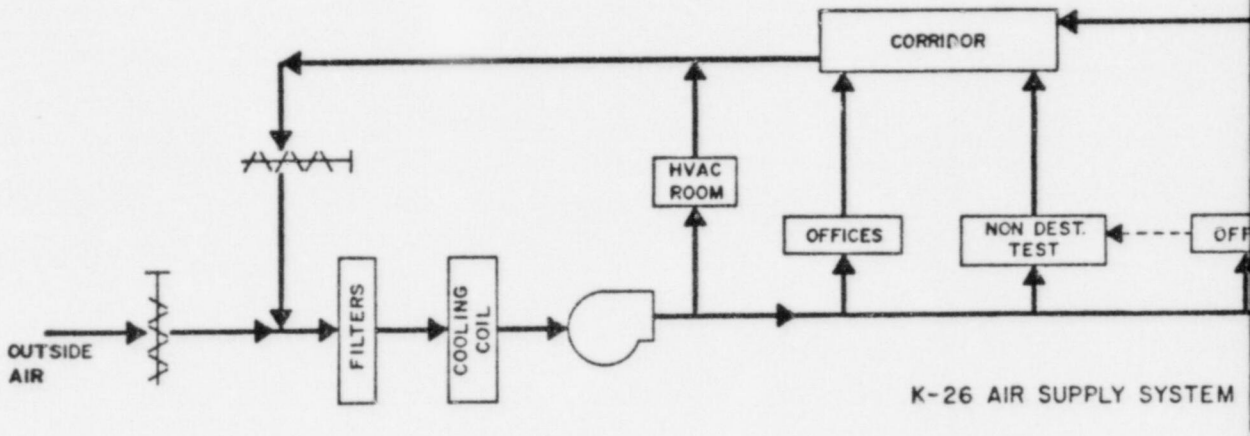
HD HEAT DETECTOR

(F.O) FAIL OPEN

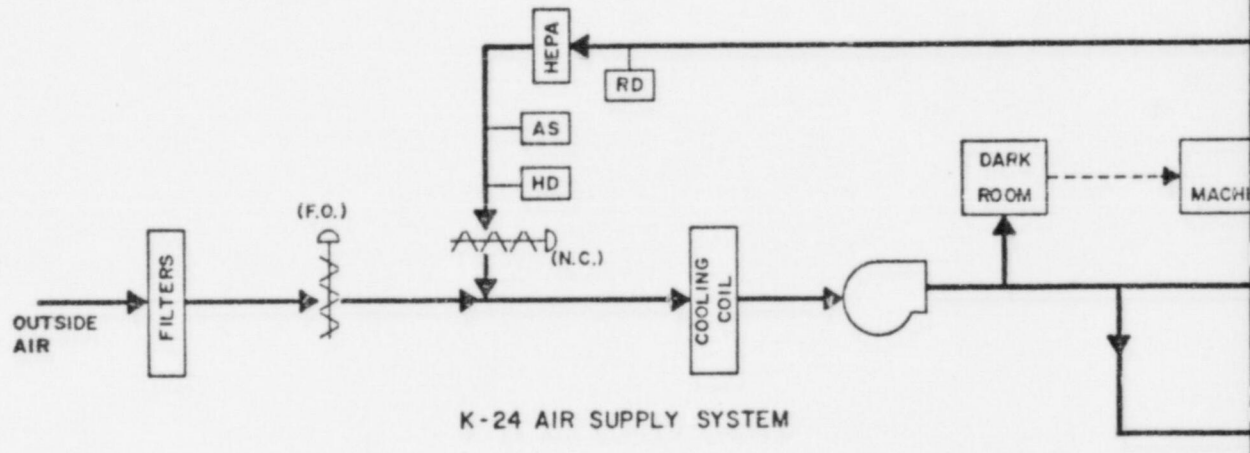
M - U_3O_8 FACILITY

FIGURE II-10.24

8609260255-25



K-26 AIR SUPPLY SYSTEM

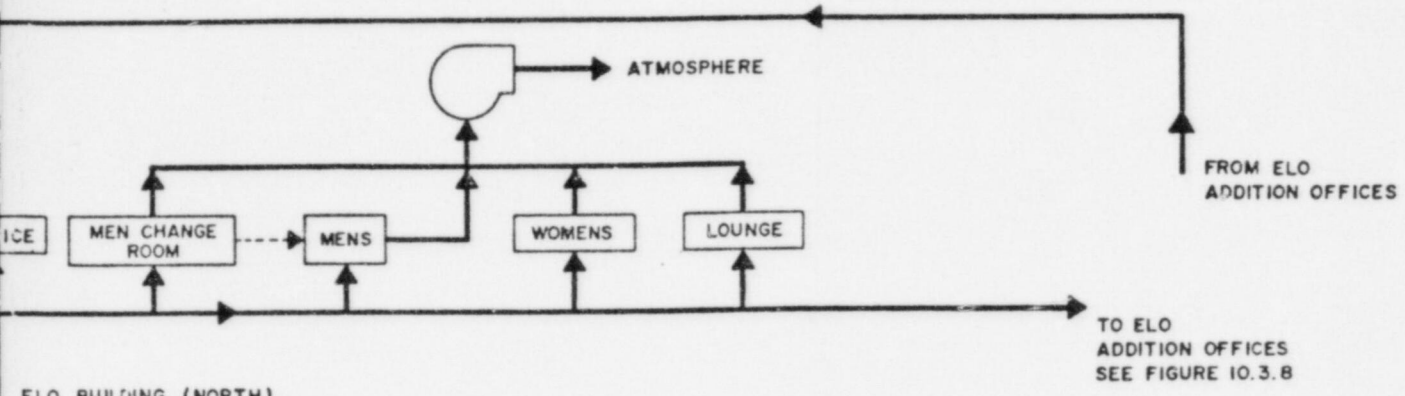


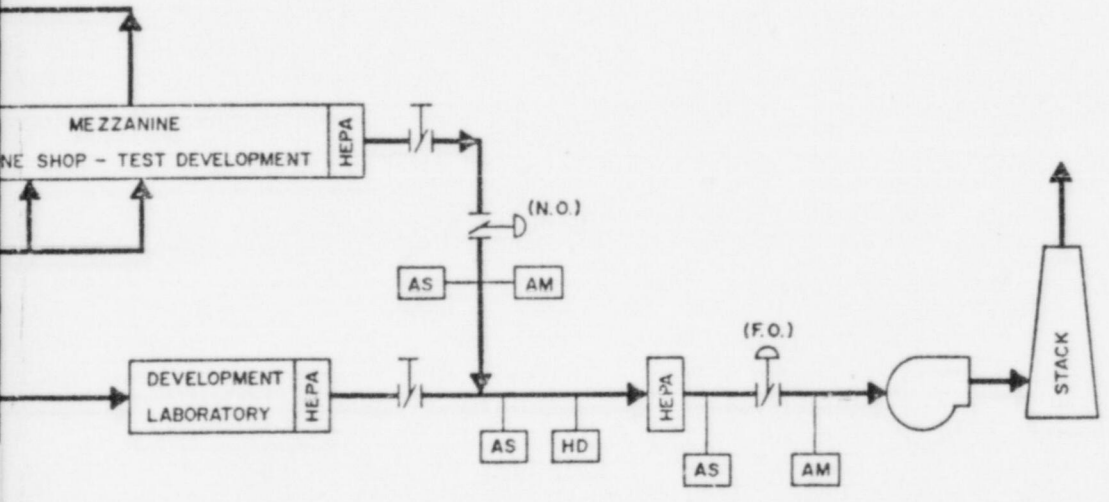
K-24 AIR SUPPLY SYSTEM

SOUTH ELO BUILDING HVAC SYSTEM 3

AM	AIR FLOW MONITOR
AS	AIR SAMPLER
HD	HEAT DETECTOR
RD	RADIATION DETECTOR
(F.O.)	FAIL OPEN
(N.C.)	NORMALLY CLOSED
(N.O.)	NORMALLY OPEN

SIMPLIFIED SCHEMATIC HVAC





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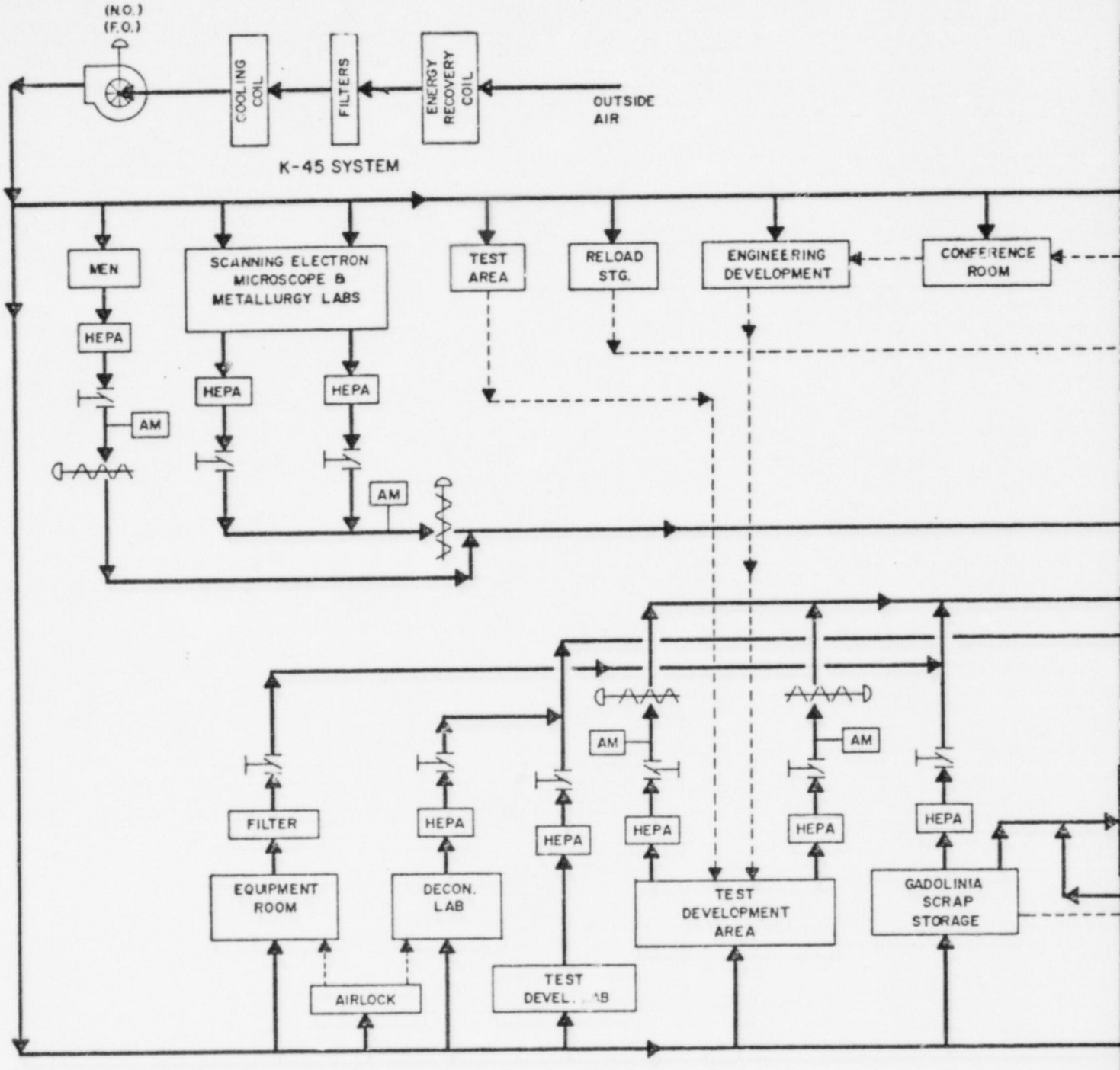
SYSTEM - ELO BUILDING

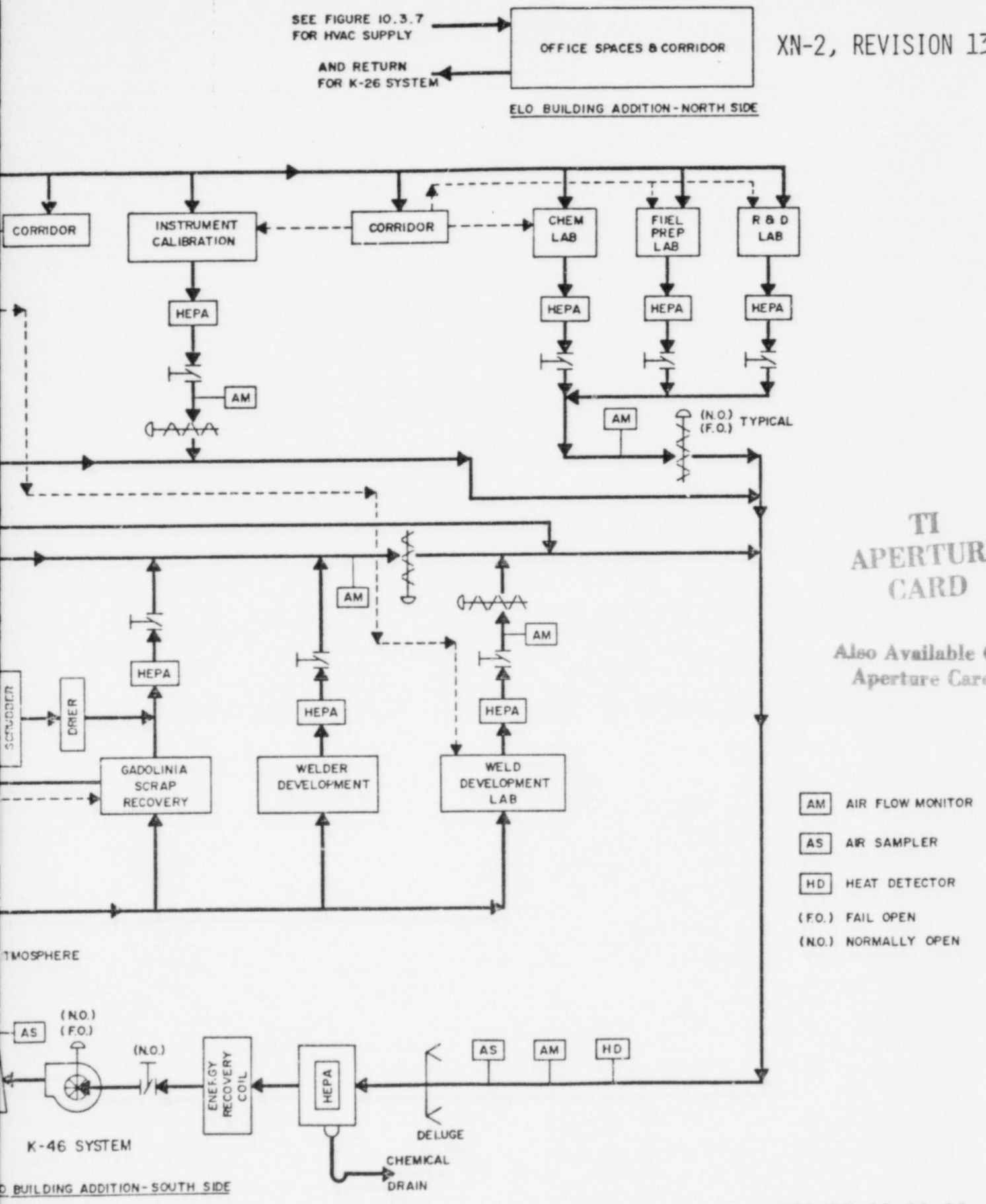
FIGURE II-10.25

8609260255-26



SIMPLIFIED SCHEMATIC HVAC SYSTEM – ELO BUILDING ADDITION

EL



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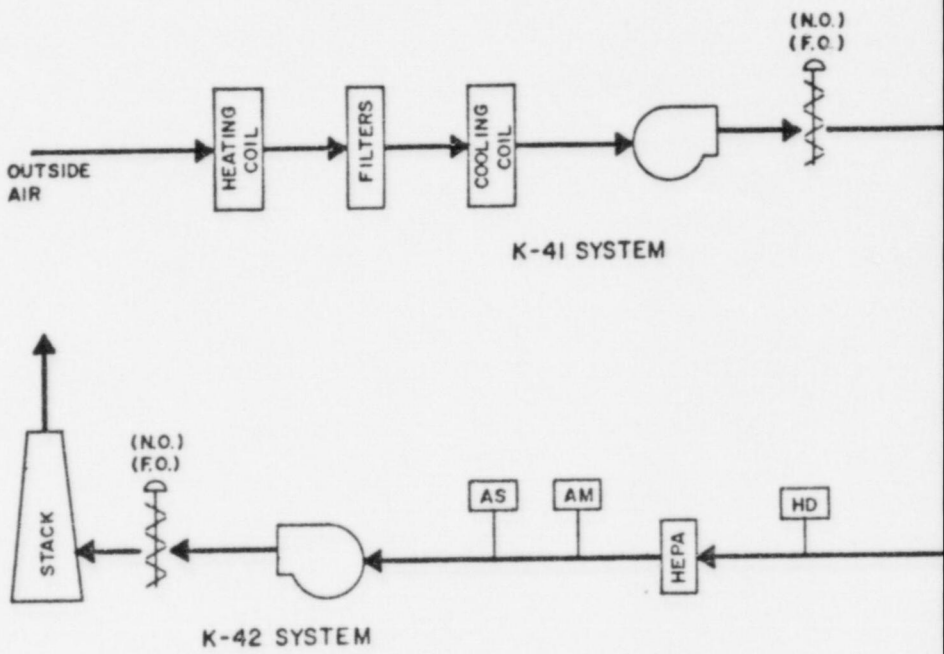
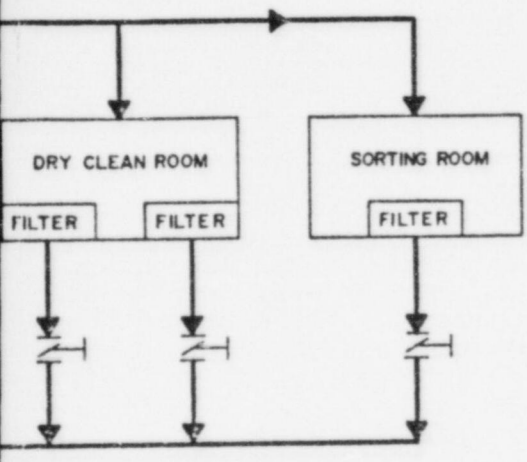
Also Available On
Aperture Card

FIGURE II-10.26

8609260255-27



SIMPLIFIED SCHEMATIC HVAC SYSTEM - CONTAMINATED CLOTH



TI
APERTURE
CARD

Also Available On
Aperture Card

ING LAUNDRY FACILITY

AM AIR FLOW MONITOR

AS AIR SAMPLER

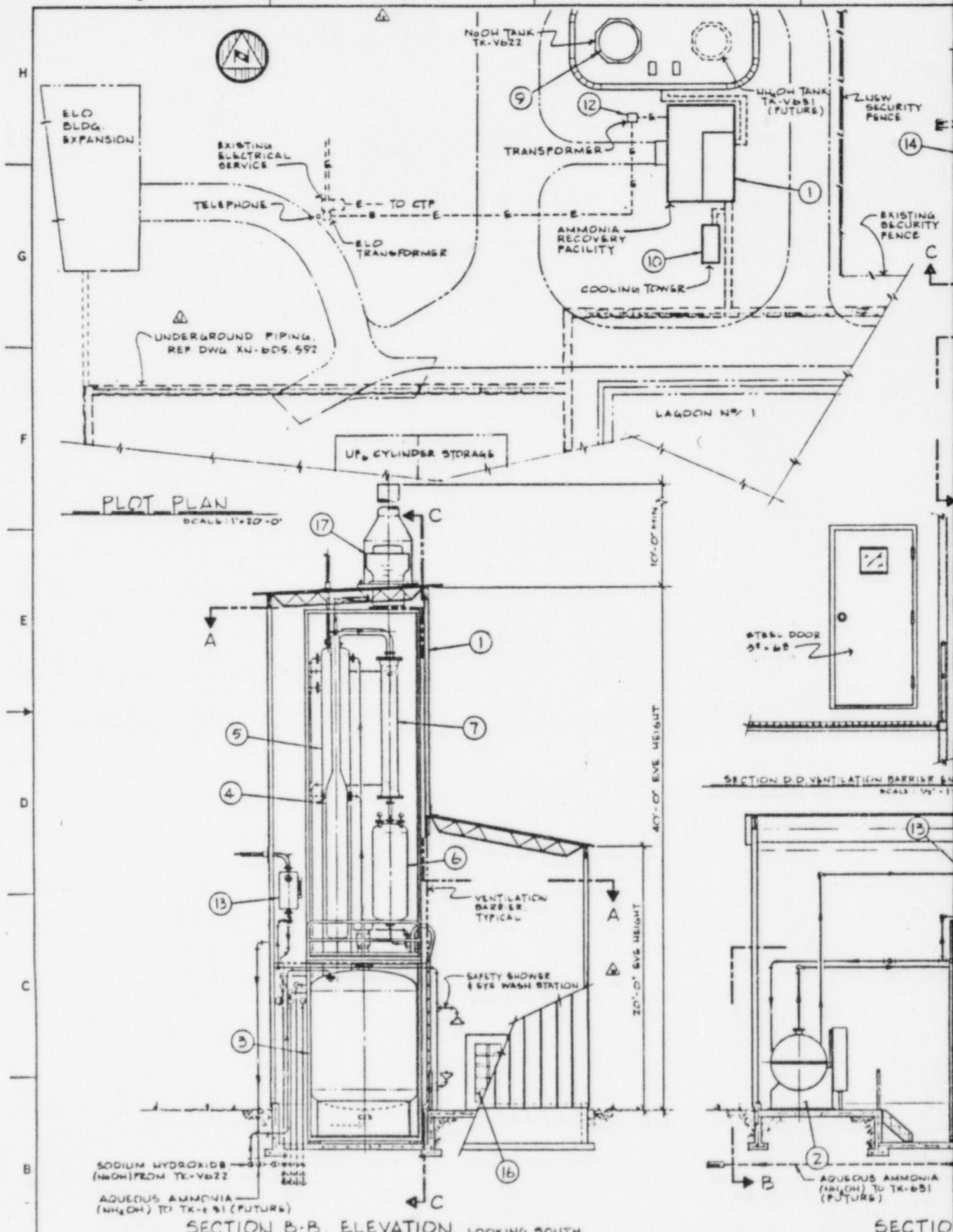
HD HEAT DETECTOR

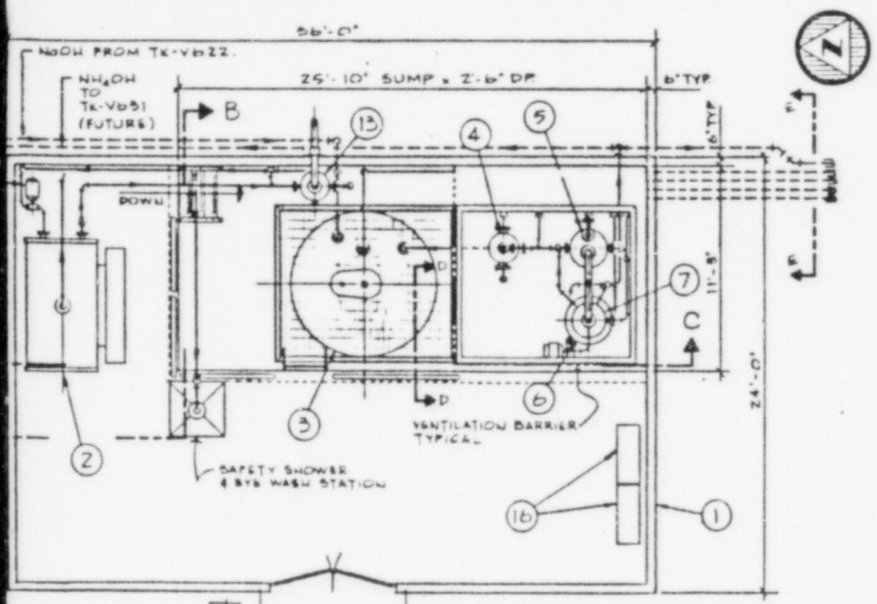
(F.O.) FAIL OPEN

(N.O.) NORMALLY OPEN

FIGURE II-10.27

8609260258-28


NaOH TANK TK-V622
NH4OH TANK TK-V631 (FUTURE)
ELD BLDG. EXPANSION
EXISTING ELECTRICAL SERVICE
TELEPHONE
TO CTP
ELD TRANSFORMER
TRANSFORMER
AMMONIA RECOVERY FACILITY
COOLING TOWER
UNDERGROUND PIPING, REF DWG XN-6DS 592
LAGOON No. 1
LIQ. CYLINDER STORAGE
PLOT PLAN
SCALE: 1"=30'-0"
EXISTING SECURITY FENCE
STEEL DOOR
VENTILATION BARRIER, TYPICAL
SAFETY SHOWER & EYE WASH STATION
10'-0" MIN
40'-0" EYE HEIGHT
20'-0" EYE HEIGHT
SODIUM HYDROXIDE (NaOH) FROM TK-V622
AQUEOUS AMMONIA (NH4OH) TO TK-631 (FUTURE)
AQUEOUS AMMONIA (NH4OH) TO TK-631 (FUTURE)
SECTION B-B, ELEVATION, LOOKING SOUTH
SCALE: 1/8" = 1'-0"
SECTION D-D, VENTILATION BARRIER ELEVATION
SECTION E-E, LINE IDENTIFICATION
NOT A DESIGN GUIDE
1" SULFURIC ACID (FUTURE).
4" COOLING TOWER WATER, RECYCLE.
4" COOLING TOWER WATER, SUPPLY.
1" DEIONIZED WATER.
1 1/2" AQUEOUS AMMONIA
2" FROM LAGOON No's 5A & B
2" TO LAGOON No's 1, 5A & B
3" WASTE FROM UO2 BLDG.
3" LAGOON No's 5 A & B WASTE TO

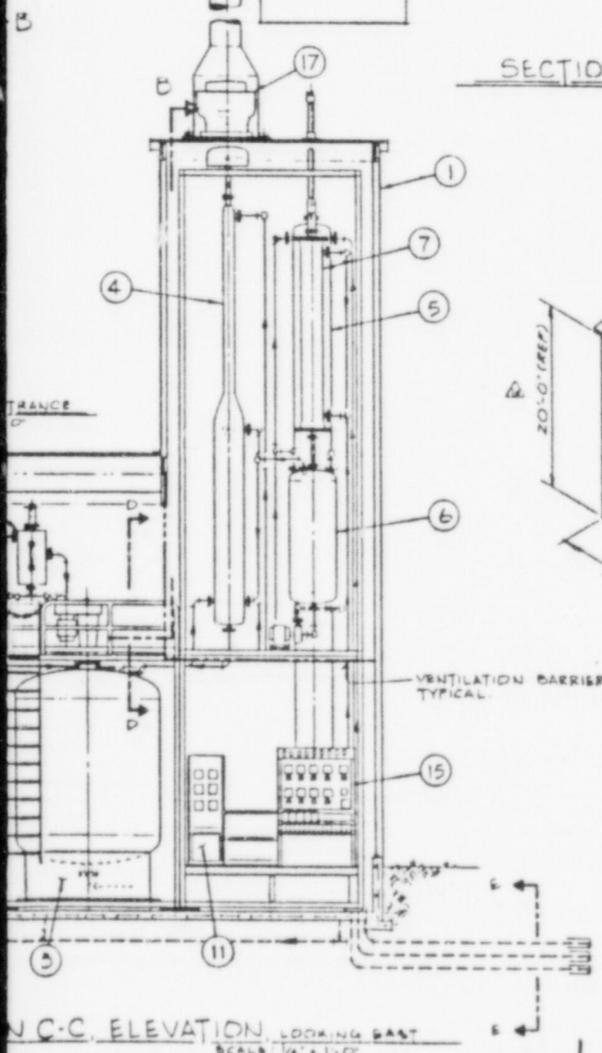


QTY	ITEM	DESCRIPTION	REMARKS
1	1	24'0" x 56'-0" PRE-FAB METAL BLDG. "GARCO" TYPE TBC ON 6" SLAB	
1	2	STEAM BOILER - "CHROMALOX" TYPE CHS 945, 945 kWe	
1	3	FEED TNK, 6'-0" O.D. x 8'-0" W/5 H.P. AGITATOR, SST CONST	
1	4	ABSORBER/SCRUBBER, BOTTOM SECTION 18" O.D. w/ 8'-0" PACKING, TOP SECTION 6'-0" O.D. w/ 8'-0" PACKING, SST CONST	
1	5	STRIPPING COLUMN, 24" O.D. x 32'-9" LG., 22 TRAY W/DEMISTER PAD & INSP. PORTS, SST CONST	
1	6	DISTILLATE TNK, 250 GAL 30" O.D. x 6'-6" LG., 30 PSIG - SST CONST.	
1	7	CONDENSER, 220 FT.² SHELL & TUBE HEAT EXCHANGER, SST CONST.	
1	8	RECOVERY HEAT EXCHANGER, 180 FT.² R & F FRAME, SST CONST.	
1	9	NaOH STORAGE TANK, 28 700 GAL 14'-0" DIA x 25'-0" HGT., C.S.	
1	10	COOLING TWR., 250 GPM, 100°F TO 80°F, 70°F WETBULB W/SAND FILTER - "BALTIMORE AIRCOIL" BAC MOD. VXT-120	
1	11	MICON CONTROL CABINET	
1	12	1000 KVA TRANSFORMER	
1	13	BLOWDOWN SEPARATOR	
1	14	HIGH PRESSURE FEED WATER PUMP	
1	15	INSTRUMENT RACK	
2	16	MOTOR CONTROL PANEL	
1	17	VENTILATION EXHAUSTER	

XN-2, REVISION 13

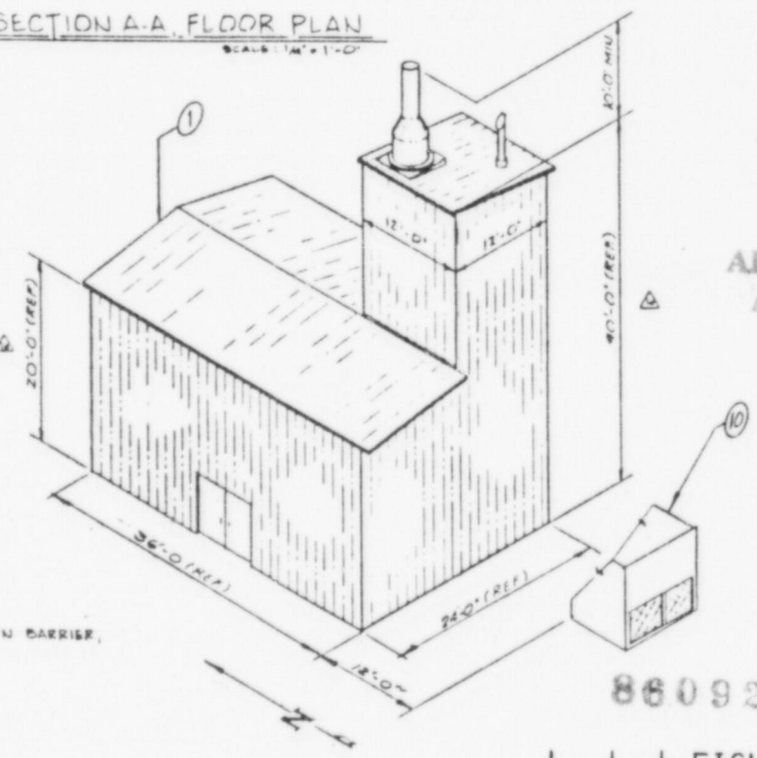
SECTION A-A, FLOOR PLAN

SCALE: 1/4" = 1'-0"



N C-C, ELEVATION, LOOKING EAST

SCALE: 1/4" = 1'-0"



CONCEPTUAL

SANITARY WATER.
COMPRESSED AIR.
LAGOON WASTE (FUTURE).
LAGOON No. 1, NEUTRALIZED WASTE.

WER.

TI APERTURE CARD

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FIGURE II-10.28

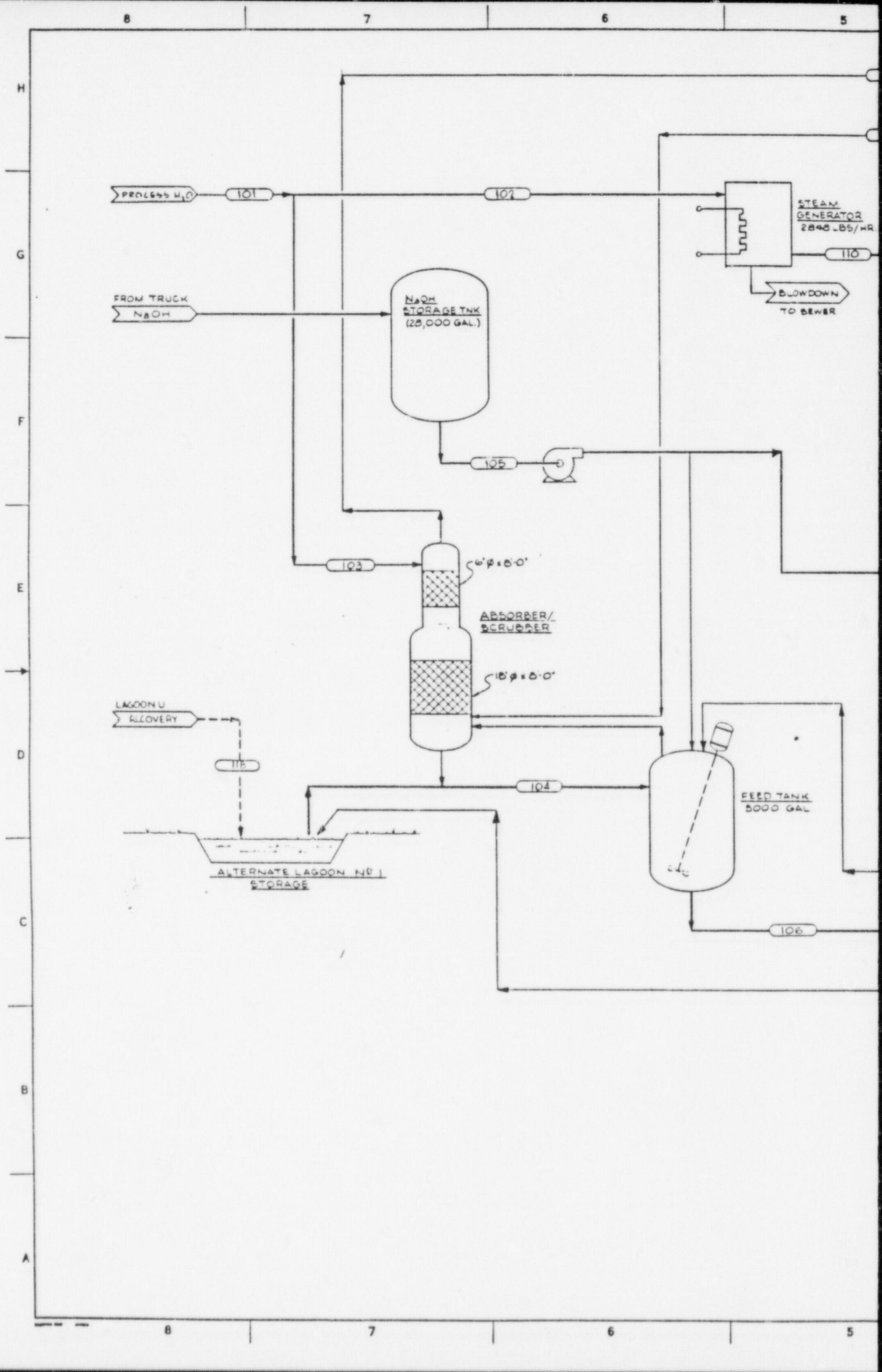
6/1/83		TANK STORAGE AND AMMONIA RECOVERY FACILITY COMPLETE REVISION OF BLDG INTERNAL	2
8/5/0		STORAGE TANKS & RELOCATED BENT NO PADS b) REALIGNED UNDERGROUND PIPING & MACH c) RELOCATED CONDENSER & DISTILLATE TANK b) INSTALLED VENTILATION BARRIER GENERAL REVISION ALL MCC'S FLD ROUT BUS WORK	1

EXXON NUCLEAR COMPANY, Inc.

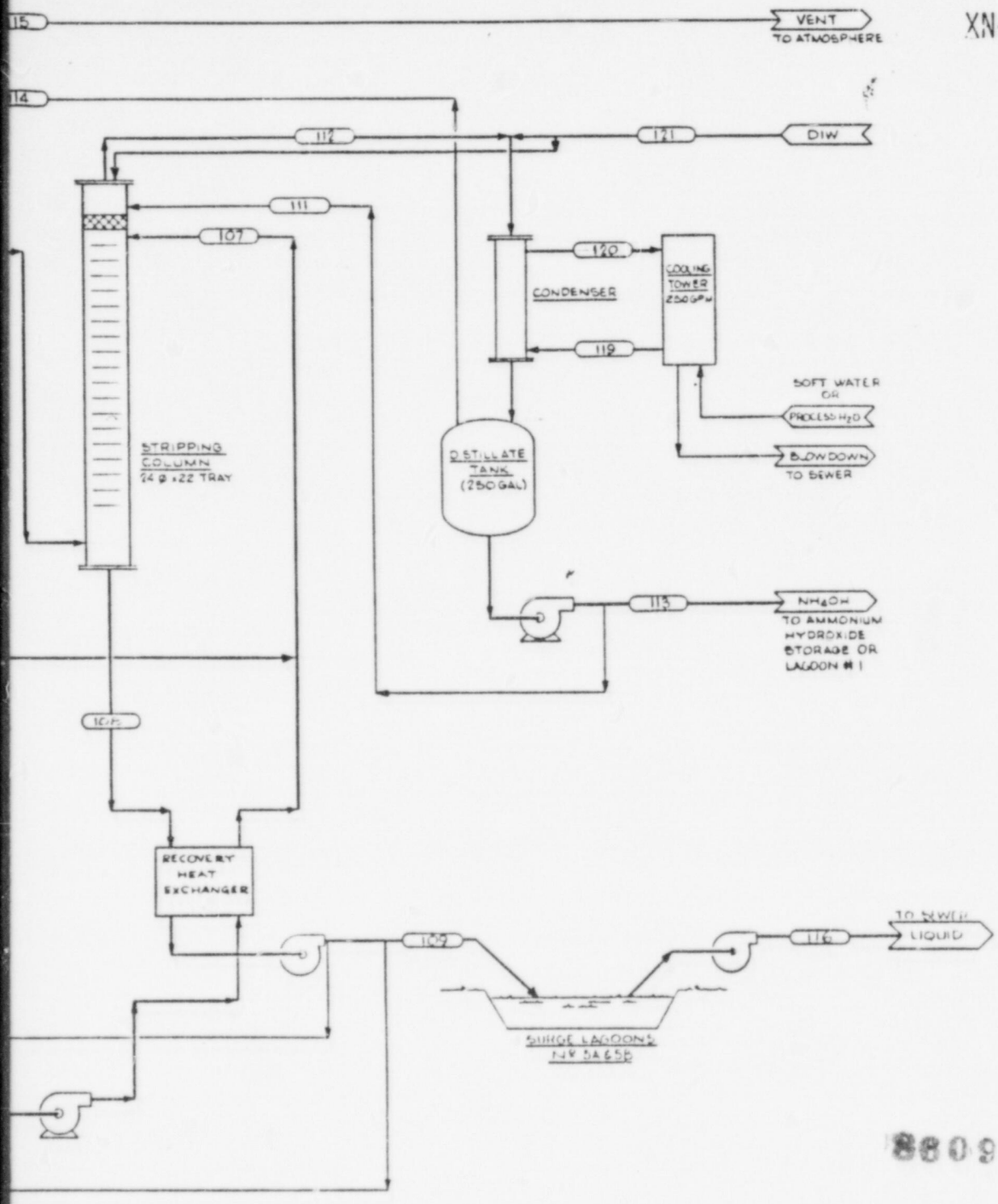
AMMONIA RECOVERY WASTE MANAGEMENT FACILITY EQUIP. ARRANGEMENT

DRAWING NO.	REV	REFERENCE DRAWING TITLE
XN-B001, 176	0	WASTE TREATMENT BATCHING, LAGOON No's 1, 5A & B PUMP STATION, ELEC'T
XN-B001, 194	0	AMMONIA RECOVERY WASTE FACILITY - PLOT PLAN & YARD PIPING
XN-605, 596	0	AMMONIA RECOVERY WASTE FACILITY - LAGOON PUMP STATION - ELECTRICAL
XN-605, 594	1	AMMONIA RECOVERY WASTE MANAGEMENT FACILITY - P&I D
XN-605, 593	0	AMMONIA RECOVERY WASTE MANAGEMENT FACILITY - BFD
XN-605, 592	1	AMMONIA RECOVERY WASTE MANAGEMENT FACILITY - SITE PLAN

DRAWN BY: K.R.B. CHECKED BY:
DRAWN BY: C.I.Bell 4/82
SCALE: INDICATED
PROJECT ENG. A. BOLDT
DRAWING NO. XN-605,592
DATE 6/1/82
XN-605-595 | 1 | 1 | 2


8
7
6
5
H
G
F
E
D
C
B
A
PROCESS H2O
101
102
STEAM GENERATOR
2898 LBS/HR
110
BLOWDOWN TO SEWER
FROM TRUCK
NaOH
NaOH STORAGE TNK
(28,000 GAL.)
105
103
6'ø x 8'-0"
ABSORBER/ SCRUBBER
18'ø x 8'-0"
LAGOON U
RECOVERY
111
104
FEED TANK
5000 GAL
ALTERNATE LAGOON NO 1
STORAGE
106

XN-2, REVISION 13



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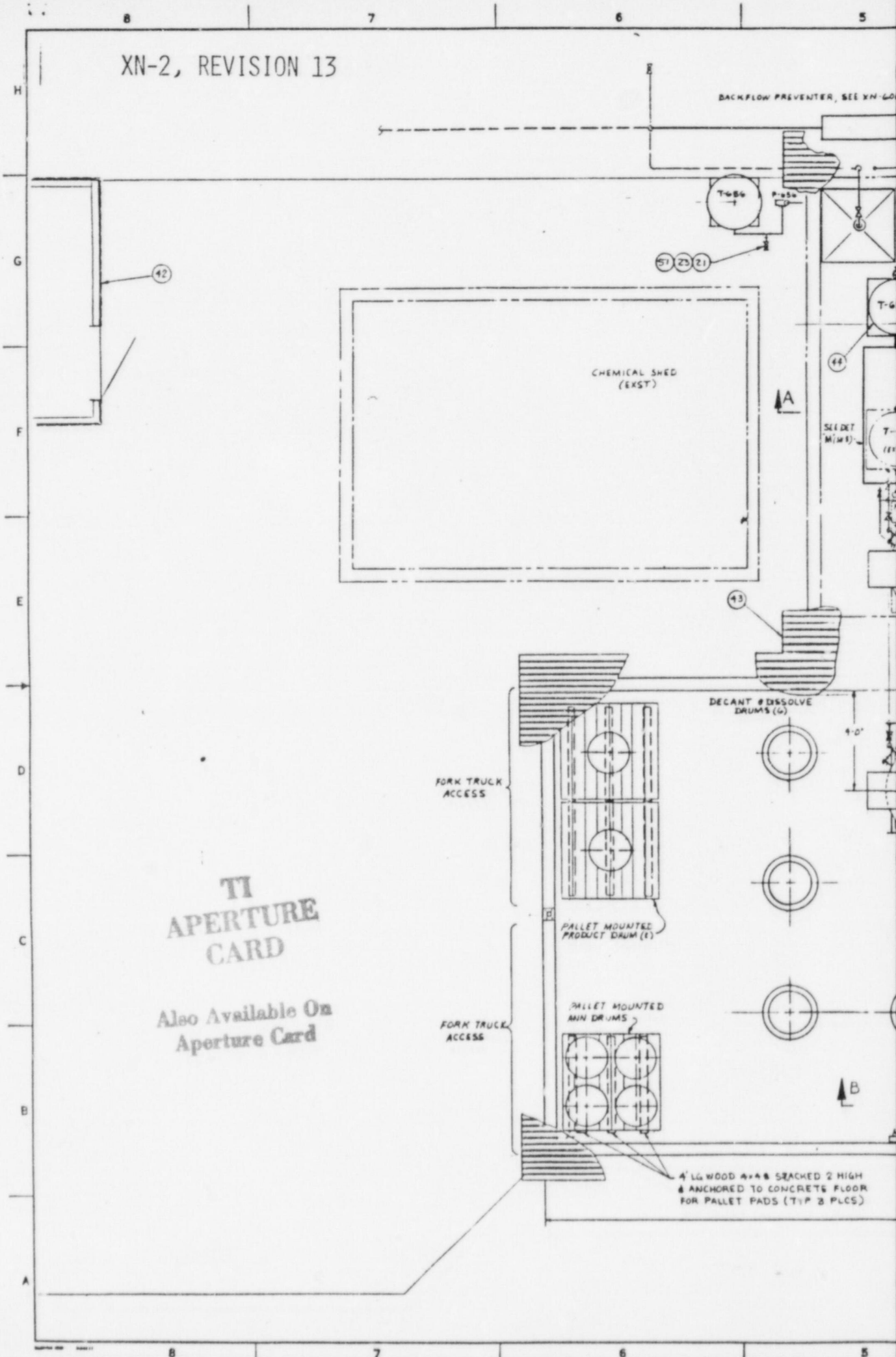
Also Available On Aperture Card

8809260255-30

FIGURE II-10.29

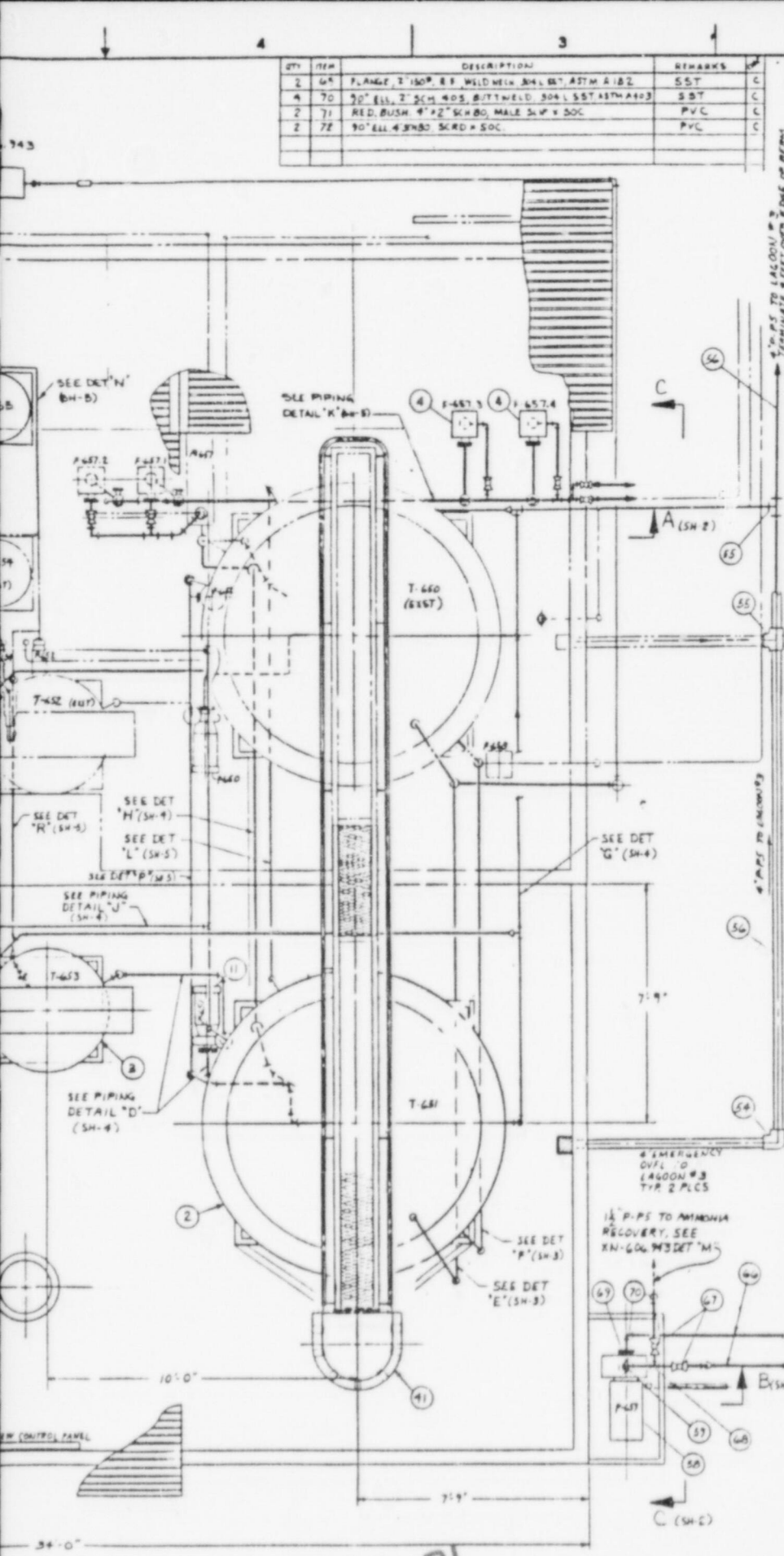
EXXON NUCLEAR COMPANY, Inc.	
AMMONIA RECOVERY WASTE MANAGEMENT FACILITY ENGINEERING FLOW DIAGRAM	
XN-605-593	1 2 2

XN-2, REVISION 13



TI
APERTURE
CARD

Also Available On
Aperture Card



QTY	ITEM	DESCRIPTION	REMARKS	
2	69	FLANGE, 2" 150# R.F. WELD NECK 304 L SST, ASTM A182	SST	C
4	70	90° ELL, 2" SCH 40S, BUTTWELD 304 L SST ASTM A403	SST	C
2	71	RED. BUSH 4" × 2" SCH 80, MALE SLIP × SOC	PVC	C
2	72	90° ELL 4" SCH 80 SCRD × SOC	PVC	C

QTY	ITEM	DESCRIPTION	REMARKS	
✕	1	ARRANGEMENT		
1	2	PRECIPITATOR (TK-651), 7000 GAL TK W/SUPPORT STRUCTURE & AGITATOR	C-E INC. ALT OR REF. P.O. R5G761	E
1	3	PRECIPITATOR WASHER (TK-653) 3500 GAL TK W/ SUPPORT STRUCTURE & AGITATOR	C-E INC. ALT OR REF P.O. R5G761	E
2	4	FILTER (F-653, 657.4) FABRI-BASKET, SE MODEL	RUNNINGEN/ PETTER	E
17	5	2" BALL VALVE, TRU-UNION, SOC. ENDS	PVC	C
1	6	1½" BALL VALVE, TRU-UNION, SOC. ENDS	PVC	C
8	7	1" BALL VALVE, TRU-UNION, SOC. ENDS	PVC	C
	8	¾" BALL VALVE, TRU-UNION, SOC. ENDS	PVC	C
1	9	DRAIN VALVE, 2" × 45°, RAM TYPE 5½" PISTON EXTENSION, SST	STRAHMAN	E
1	10	DRAIN VALVE, 1" × 45°, RAM TYPE 3¾" PISTON EXTENSION, SST	STRAHMAN	E
1	11	PUMP, CARVER, 7½ HP, 170 GPM, @ 21½ TDH	CARVER	E
200'	12	2" PIPE, SCH 80	PVC	C
25'	13	1½" PIPE, SCH 80	PVC	C
170'	14	1" PIPE, SCH 80	PVC	C
9	15	FLANGE, 2"-150#, SOCKET, FLAT FACE	PVC	C
34	16	90° ELL, 2" SCH 80, SOCKET	PVC	C
1	17	45° ELL, 2" SCH 80, SOCKET	PVC	C
10	18	TEE, 2" SCH 80, SOCKET	PVC	C
1	19	FLANGE, 1"-150#, SOCKET, FLAT FACE	PVC	C
6'	20	PIPE, ¾" SCH 80, PVC	PVC	C
1	21	TEE, ¾" SCH 80, SOCKET	PVC	C
4	22	90° ELL ¾" SCH 80, SOCKET	PVC	C
4	23	½" BALL VALVE, TRUE UNION, SOCKET	PVC	C
20'	24	¾" PIPE, SCH 80	PVC	C
2	25	TEE, ¾" SCH 80, SOCKET	PVC	C
3	26	90° ELL ¾" SCH 80, SOCKET	PVC	C
9	27	¾" BALL VALVE, TRUE UNION, SOCKET	PVC	C
7	28	TEE, 1" SCH 80, SOCKET	PVC	C
8	29	90° ELL 1" SCH 80 SOCKET	PVC	C
1	30	MALE ADAPTER, 3" NPT × 3" SOCKET	PVC	C
1	31	3" × 2" BUSHING, SLIP × SOC, SCH 80	PVC	C
1	32	FLANGE, 3" 150# SCREWED FLAT FACE	PVC	C
1	33	BLIND FLANGE, 3" 150# MODIFY PER DET "H" (SH-4)	PVC	C
3	34	90° ELL, 1½" SCH 80, SOCKET	PVC	C
1	35	45° ELL, 1½" SCH 80, SOCKET	PVC	C
4	36	TEE, 1½" SCH 80, SOCKET	PVC	C
3	37	45° ELL, 1" SCH 80, SOCKET	PVC	C
2	38	SOLENOID VALVE, 2", SCRD, PVC	PLASTOMATIC #SPC200BG20	E
2	39	ADAPTER, 2" SCH 80, MALE THREAD × SOCKET	PVC	C
2	40	COUPLING, 2" SCH 80, SOCKET	PVC	C
1	41	CATWALK HANDRAIL & LADDER CAGE	XN-606-951	C
1	42	CHANGE ROOM	XN-606-954	—
1	43	AWNING	XN-606-953	—
1	44	FILTER BAG WASH TANK (T-652)	ON HAND	E
1	45	REDUCING COUPLING, 2" × 1" SCH 80, SOCKET	PVC	C
1	46	¾" BALL VALVE, SCRD, TRU-UNION	PVC	C
1	47	BUSHING, ¾ MALE THRD × ¼ SOCKET	PVC	C
6	48	90° ELL, 1" SCH 80, THRD × SOCKET	PVC	C
1	49	90° ELL ¾" SCH 80, THRD × SOCKET	PVC	C
1	50	RED. BUSHING, 2" × ½" MALE SLIP × SOCKET	PVC	C
1	51	NIPPLE, ½" SCH 80 PIPE × 2" LG	PVC	C
2	52	90° ELL, 2" SCH 80, THRD × SOCKET	PVC	C
2	53	HOSE CONNECTOR		C
1	54	90° ELL, 4" SCH 80, SOCKET	PVC	C
2	55	TEE, 4" SCH 80, SOCKET	PVC	C
	56	PIPE, 4" SCH 80,	PVC	C
1	57	FLEX HOSE 1" × 6" LG FLG ONE END	REINFORCED RUBBER	C
1	58	PUMP SELF PRIME, MARLOW # 1½ HE 19EL 3 HP 160 GPM, (P657) 3Ø 460V	MARLOW	E
1	59	PRESSURE GAUGE, 0-60 PSI, ASHCROFT SERIES 9001	SST	C
1	60	FLANGE, 1½" 150# R.F. SOCKET	PVC	C
1	61	RED. BUSHING, 2" × 1½" SOC × MALE SLIP SCH 80	PVC	C
1	62	FLANGE, ¾" 150# FLAT FACE, BLIND	PVC	C
1	63	FLANGE, ¾ 150# FLAT FACE, SOCKET	PVC	C
1	64	FLEX HOSE 1" × 6" LG	REINFORCED RUBBER	C
3	65	RED BUSH 1½" × ½" SCH 80 MALE SLIP × SOC	PVC	C
	66	PIPE, 2" SCH 40S, 304 L SST, ASTM A312	SST	C
2	67	VALVE, 2" SST		C
1	68	TEE, 2" SCH 40S, BUTTWELD 304 L SST, ASTM A403	SST	C

(CONT'D LEFT)

FOR NOTES SEE SHEET #2

REV	DESCRIPTION	DATE	APPROVED
1	AS BUILT	9/7/82	

EXXON NUCLEAR COMPANY, Inc.
RICHLAND, WASHINGTON 99352

LAGOON URANIUM RECOVERY PRODUCTION FACILITY

EQUIPMENT ARRANGEMENT

DRAWING NO.	REV	REFERENCE DRAWING TITLE
XN-607678		NO₂ EXHAUST SYSTEM
XN-606-283	3	LAGOON URANIUM RECOVERY ELECTRICAL INSTALLATION
XN-606-959	0	LAGOON URANIUM RECOVERY AWNING
XN-606-954	0	LAGOON URANIUM RECOVERY CHANGE ROOM
XN-606-951	0	LAGOON URANIUM RECOVERY LADDER CAGE CATWALK ASS'Y.
XN-606-943	0	LAGOON URANIUM RECOVERY ENGINEERING FLOW DIAG.
XN-606-943	0	LAGOON URANIUM RECOVERY PRODUCTION FACILITY SITE PLAN

APPROVED: T.M. Keith 5/9/82
GIL KEITH
DRAWN BY: J. ALEXANDER 3-1-82
SCALE: ½" = 1'-0"

XN-606-943

XN-606-944 | 1 | 5 | 1

8609260255

FIGURE II-10.30

EXXON NUCLEAR COMAPNY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

DISTRIBUTION LIST

C.P. Cormier
Ancon Insurance Comoany, S.A.
Post Office Box 225
Hamilton, Bermuda

P.R. McMurray
Exxon Nuclear Company, Inc.
600 108th Avenue, N.E. C-00777
Bellevue, WA 98009

I.T. Tobye
Risk Management Coordination
Exxon Corporation
1251 Avenue of the Americas
New York, NY 10020

S. Pubchara
Exxon Risk Management Services, Inc.
P.O. Box 3342
Houston, TX 77001

W.C. Kohfeldt
Central Engineering Division
Exxon Chemical Company
P.O. Box 271
Flornam Park, NJ 07932

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Exxon Enterprises Inc.
1251 Avenue of the Americas
New York, NY 10020

R.F. Murpny
Exxon Research & Engineering Co.
P.O. Box 101
Flornam Park, NJ 07932

J.C. Vlastelica
Exxon Nuclear Company, Inc.
600 108th Avenue, N.E. C-00777
Bellevue, WA 98009

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

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PROPERTY LOSS PREVENTION REPORT

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

INSPECTED BY: J. P. Abrenica DATE: April 26 & 27, 1983

CONFERRED WITH: Messrs: D.L. Cornell, Manager-Plant Operations
T.L. Davis, Manager-Auxilliary Operations
R.W. McCullugh, V.P. Engineering & Production
T.C. Probasco, Industrial & Nuclear Safety Engineer
J. Vlastelica, Comptroller

I. MANAGEMENT SUMMARY

A. Major Changes Since Previous Inspections

Automatic sprinkler protection has been provided throughout the new two story Office Building No. 8, except for the first story section used for computer operations. A fixed, automatic halon extinguishing system has been provided for the computer area. Other major buildings that have been added are Office Buildings Nos. 6 and 7, the Machine Shop and the addition to the ELO Building which is used as engineering offices.

The sintering furnace and two offgassing furnaces are being installed in the main production building. Plans for these installations were previously reviewed by M&MPC Seattle and construction is to be in accordance with the plans and comments made during the review.

B. Current Major Deficiencies

The lack of automatic sprinkler protection in the Warehouse and Office Building No. 5 continues to be a major fire protection deficiency. The exhaust ventilation systems for the Uranium Oxide Building and the Special Fuels Building are critical units needed for continued production at this plant. These units are exposed to fire losses due to combustible filters and the proximity of the exhaust stacks and fans to trailers used as offices and storage areas.

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

II. RECOMMENDATIONS

A. Recommendations Completed

None

B. New Recommendations

Section A - Recommendations Which Fall Within The BP Guidelines

None

Section B - Recommendations Exceeding Or Not Covered By The BP Guidelines

Category I - Major Deficiencies

None

Category II - Lesser Deficiencies

83-1 The exhaust ventilation systems for the Uranium Oxide Building and Special Fuels Building consist of filter banks located inside the buildings and outdoor exhaust stacks and blower fans. These are critical units as the plant cannot operate without them due to governmental regulations. The following is therefore recommended to minimize losses involving this equipment.

a. The existing automatic sprinklers at the inlet sections of the filter housing should be extended to cover the entire section occupied by the combustible filters. The existing control valves for the systems should be either replaced with indicating type valves or kept sealed in the fully opened position.

b. The trailers used temporarily for offices and storage should be relocated at least 50 feet away from the exhaust stacks and blower units.

83-2 The local water department should be patitioned to improve the existing water supply at the south section of the plant by restoring the 10 inch supply section which reportedly was abandoned due to leaks in the system. Water tests indicate that with a flow of 760 gpm the residual pressure at the plant is only 8 psi with water supplied through the south connection only. A flow of 1640 gpm with a residual 40 psi was obtained from the north section supply line.

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

83-3 The monthly inspection program should be improved by conducting drain tests on the sprinkler risers and checks on the control valves for the fire water lines. During the visit several underground control valves were found partially closed.

83-4 For best protection in the computer facility in Building No. 8 the following is recommended:

a. A concentration test should be conducted on the newly installed halon extinguishing system to verify that the system can provide the recommended 5-6% halon concentration.

b. The existing trash cans should be replaced with self-extinguishing types.

c. Waterproof covers should be kept on hand for use in the event of an emergency and to minimize damages from accidental water discharge from the second floor area.

83-5 To minimize losses involving the outdoor propane storage drums, an automatic water spray system is recommended. The water spray system should be activated either by heat actuated detectors (HAD) or hydrocarbon gas detectors.

Category III - Minor Deficiencies

83-6 Shredded paper should not be stored in the air handling Room 419 of Building No. 84. Signs indicating this are posted, however, the rule is not being followed.

83-7 The gasoline driven portable steam generator should not be operated in the warehouse building as this can provide and ignition source for combustibles in the area. A one hour rated partition is recommended for this operation. An alternate would be to relocate this to a less important building.

83-8 The electric dryer used to dry springs for the fuel rods is located next to Dip Tanks of acetone and alcohol. These two operations should be kept separate to minimize ignition of flammable materials.

83-9 Flammable liquids in 5 gallon cans, consisting mostly of isopropanol, should not be stored or temporarily kept in the Motor Control Center and next to the main process

control panels in the Uranium Oxide Building. These materials should be stored in a properly protected area or kept away from important facilities.

83-10 The storage of paper supply in cartons next to the first story open stairway in Building No. 8 should be relocated to a separate storage room or area with sprinkler protection provided.

C. Previous Recommendations Outstanding

80-1 Due to combustible construction and/or occupancy automatic sprinkler protection is recommended to minimize a serious fire loss in the following areas:

a. Building No. 5 of the office building complex

b. Warehouse building

COMMENT: These two areas contain considerable combustibles that it is felt sprinkler protection is warranted hence this recommendation is being resubmitted.

80-3 The undiked auxiliary generator diesel oil storage tanks located in the north and south equipment rooms of the Uranium Oxide Building should be provided with curbs or metal dikes and drains to a safe location.

COMMENT: Plant is in the process of providing curbs.

III. SPECIFICS EVALUATED

A. Specific Changes Since Previous Inspection

Office Buildings Nos. 6, 7 & 8 have been added, along with an extention to the ELO building which is used as engineering offices. A new machine shop building has also been constructed.

To improve production efficiency a sintering furnace and two offgassing furnaces are being installed in the Uranium Oxide Building. Installation is to be in accordance with previously reviewed plans.

B. Analysis of Fire Protection Water Supplies

Extensive water tests were conducted during the visit. The plant is provided with two connections to 10 inch public mains, one from the north end and another from the south end. A test on the system resulted in a flow of 1840 gpm with a static

pressure of 75 psi and a residual pressure of 45 psi. With the south supply shut off, a flow of 1640 gpm was obtained with static pressure of 75 psi and residual pressure of 40 psi. However, with the north supply shut off the resulting flow was only 760 gpm with a static pressure of 70 psi and a residual pressure of 8 psi. A thorough check was made on the underground control valves and some valves were found partially shut. Control valve No. 4 was found six turns shut, control valve No. 7 was three turns shut and control valve No. 5 was half-way shut. This illustrates the importance of conducting periodic inspections of the valves to make sure that they are maintained in the wide open position. All the valves were fully opened and a retest of the system resulted in similar test results. The local water department was contacted and it was later learned that a section of the 10 inch public main supplying the south side of the plant has been impaired and is still out of service. This section is presently supplied through 6 inch lines as part of a gridded system. As noted from the tests, there is a serious water supply deficiency if the north side supply is lost as very limited water is available from the south side. Improvements are, therefore, being recommended.

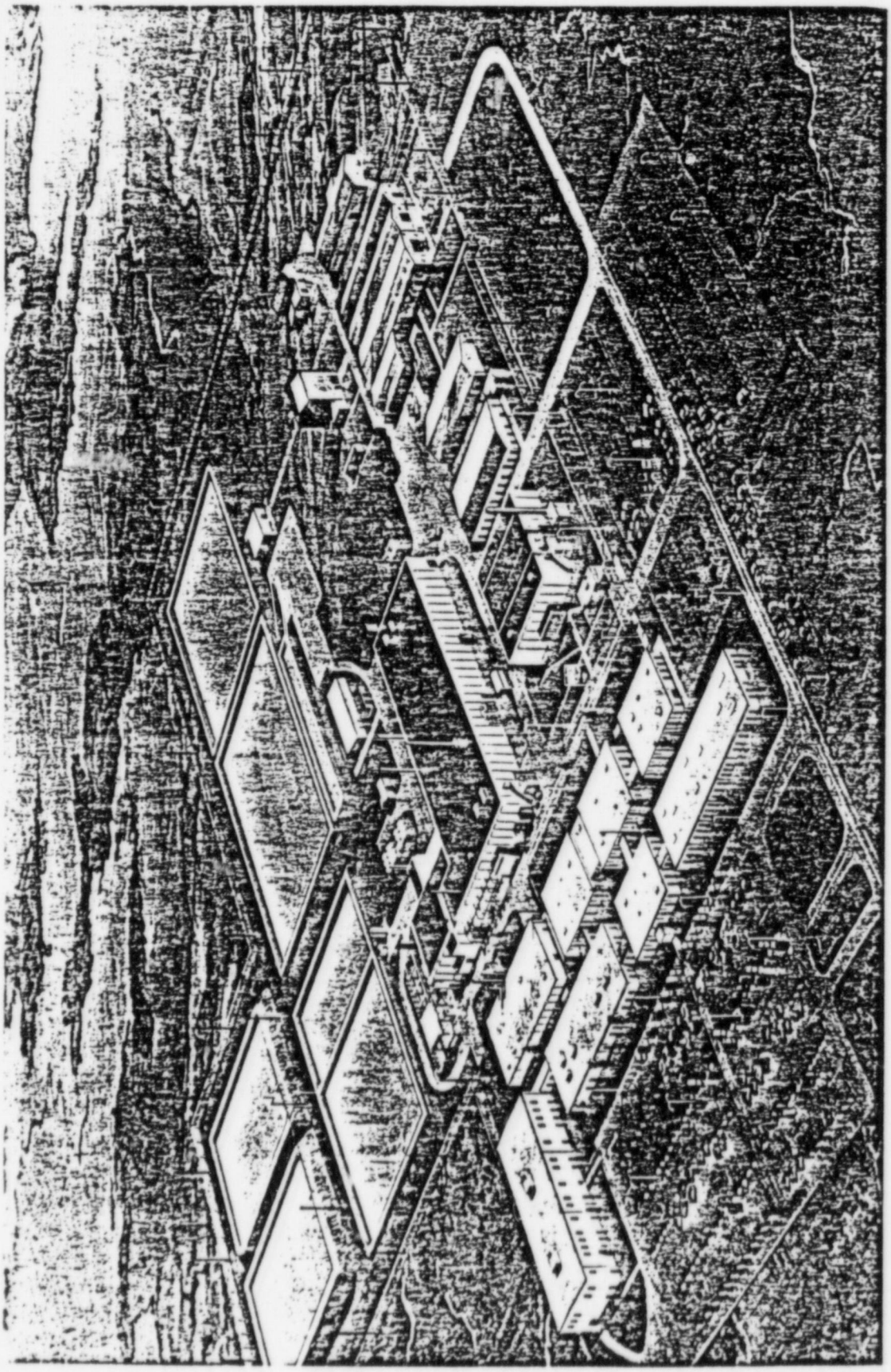
C. Exposures To Third Parties Arising From Actions Of The Plant

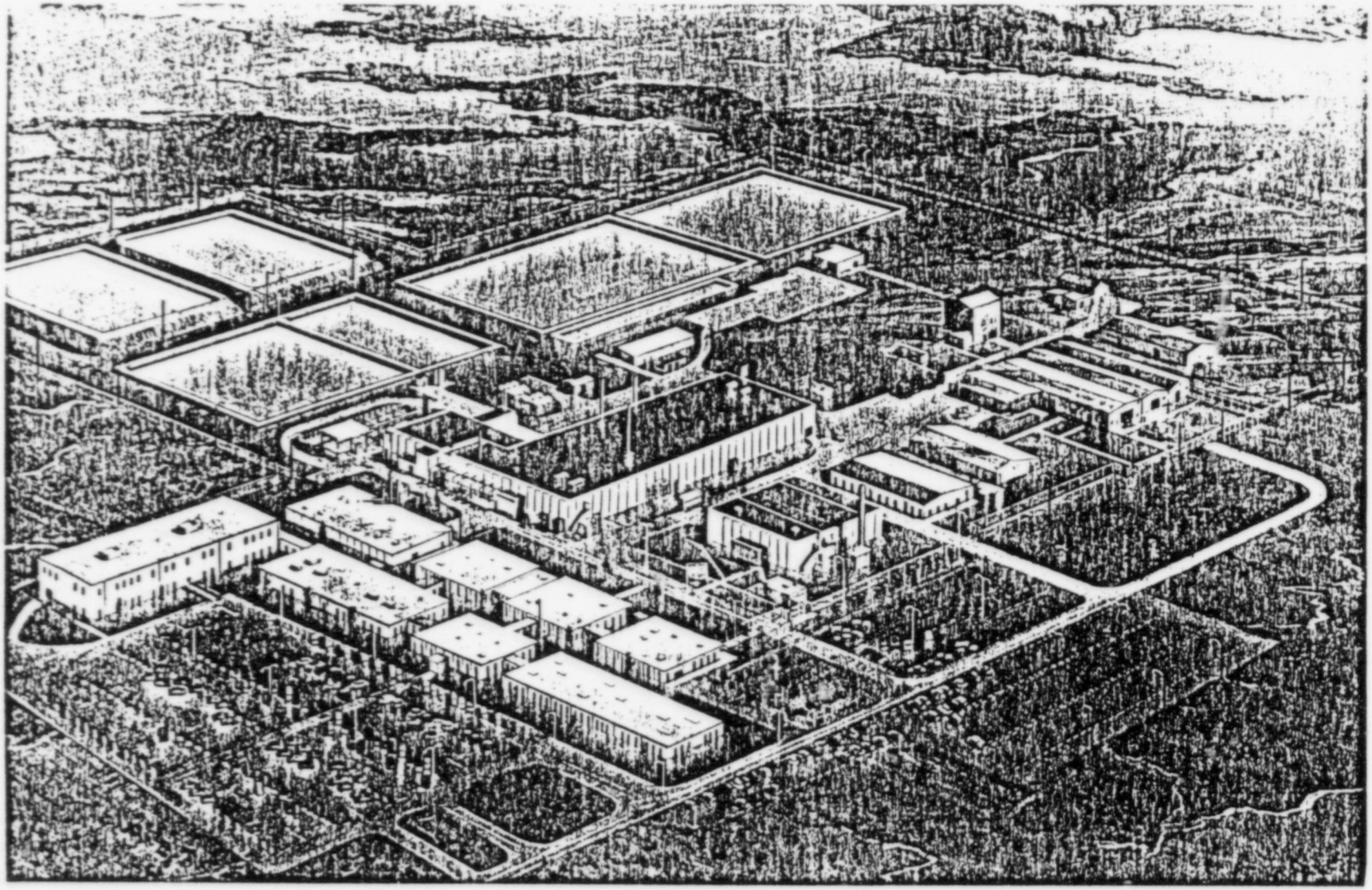
The facility is well separated from other properties and is surrounded by open areas. The nearest property is closer than 3 miles but not within ½ a mile. A location factor of 03 is being assigned.

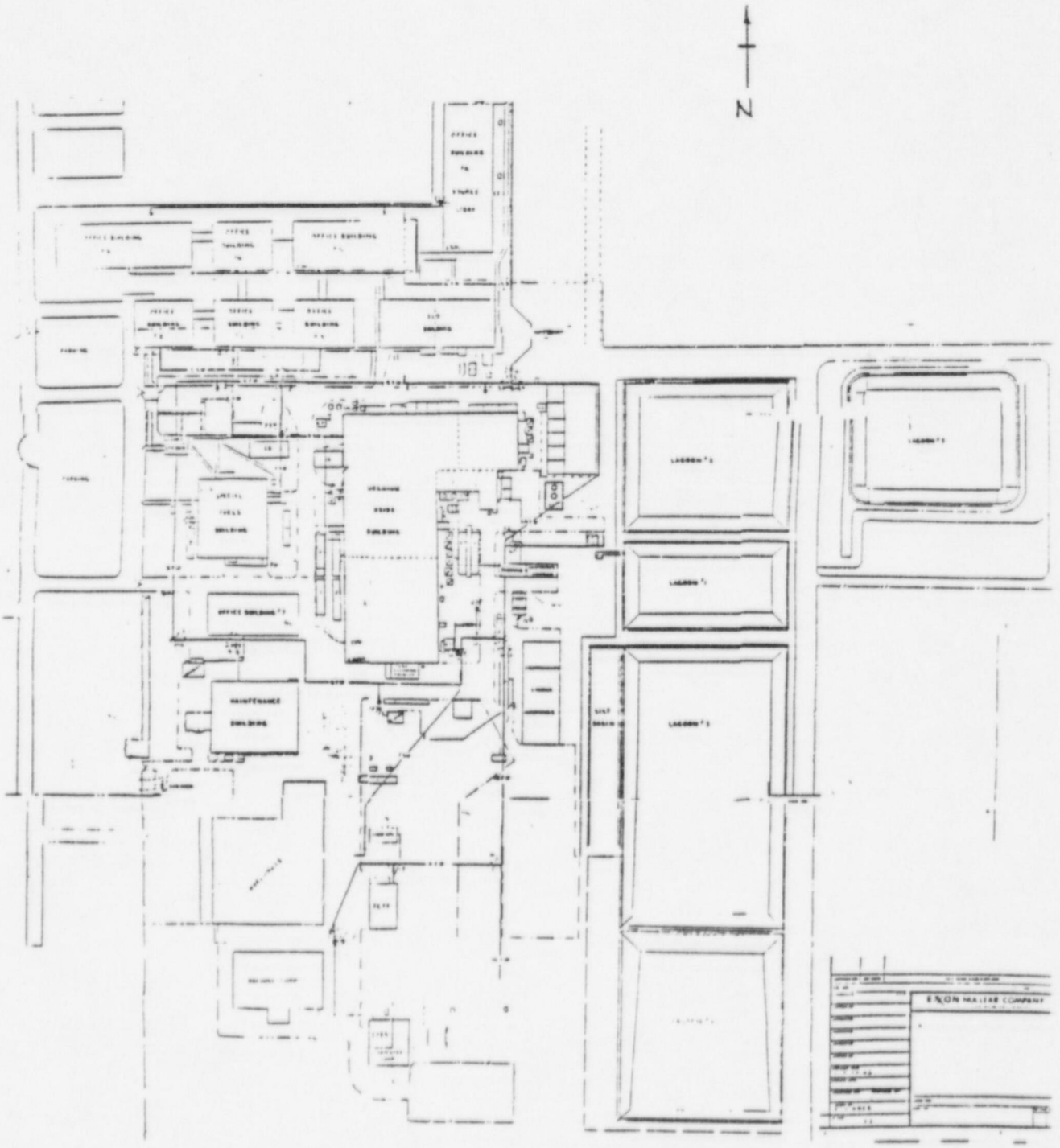
IV. ATTACHMENTS

Plot Plan
Aerial Drawing
Pump Water Test Data
Waterflow Analysis

19.44






N
EXXON NUCLEAR COMPANY

Pump and Water Test Data

Mr. Protection Consultants

Account: Exxon Nuclear Company, Inc.
Location: Richland, Washington

Conducted By: J. P. Abrenica
Date: April 26, 1983

	Pump Data					Pressure Data			Flow Data					
Test No.	Pump No.	Pressure Suct	Disch	Net	R.P.M.	Location of Hyd. No.	Static Press.	Resid Press.	Location of Hyd. No.	Outlet Diam. & Coeff.	Pitot Press.	Flow	Total Flow	Remarks (Amps., Volts, Steam Pressure, etc.)
1						Hyd. U79 South of Uranium Oxide Building	75	45	Hyd. U78 East of Uranium Oxide Building	2 - 2½"	30,30	920 920	1840	All supply valves open
2						"	75	40	"	2 - 2½"	24,24	820 820	1640	South supply valve No. 1 shut.
3						"	70	8	"	2 - 2½"	5, 5	380 380	760	North supply valve No. 6 shut.

Model No. _____ Lit./Min. kPa
Pump Design Data: _____ G.P.M. _____ P.S.I. _____ R.P.M.
Relief valve setting _____ Size: _____
Type of priming for centrifugal pump _____
Horizontal, Vertical Pump _____
Number of Stages _____
Lift _____ (Water Level to Discharge)

Driver _____ Horsepower at Rated R.P.M.
Speed Governor setting _____ R.P.M.

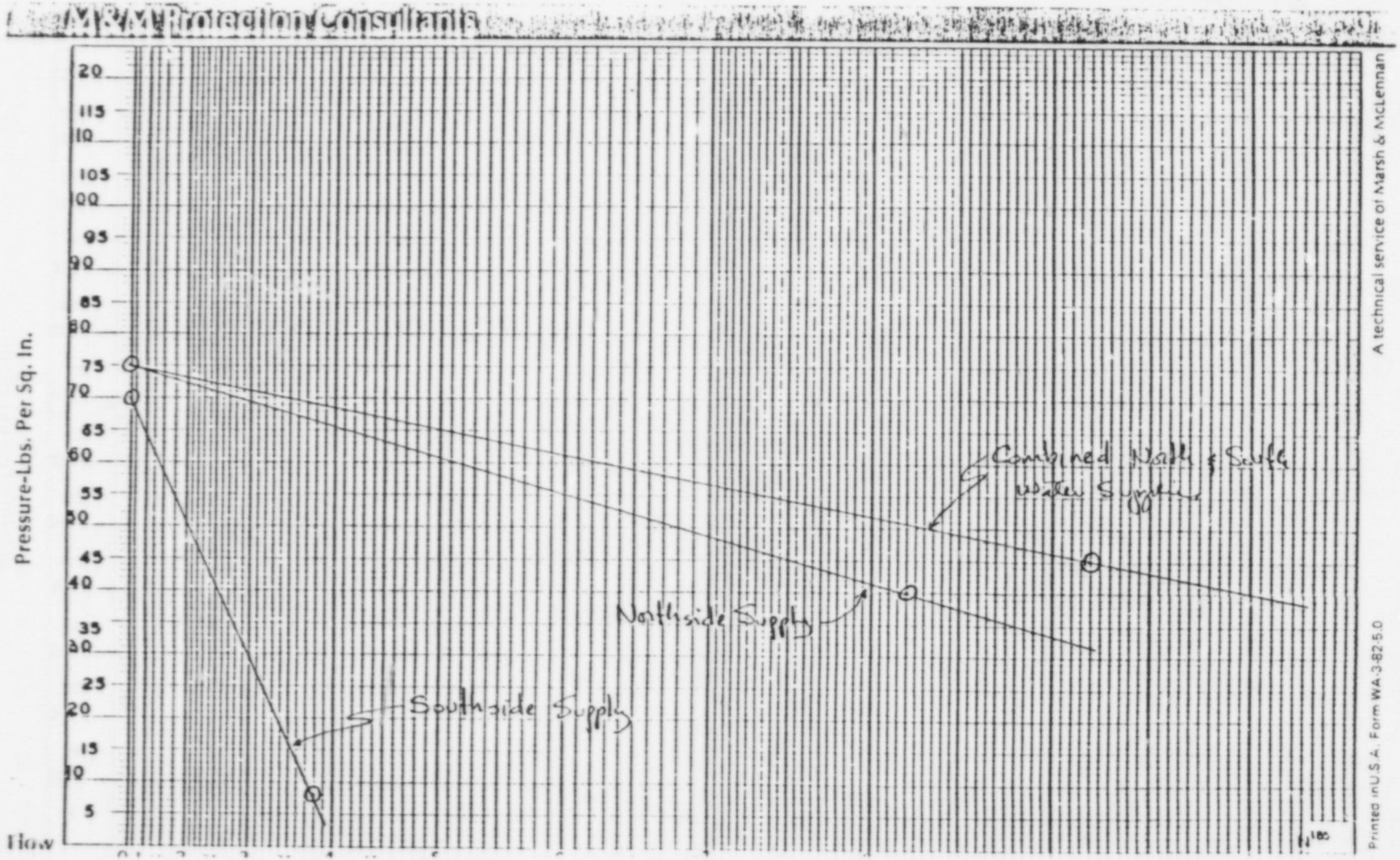
Waterflow Analysis

Highest Sprinkler Bldg. No. _____ _____ Ft. Abv. Residual Pressure

Property Exxon Nuclear Company, Inc. Location Richland, Washington Date April 26, 1983 By J. P. Abrenica

Building No. Area of Application Design Density G.P.M./Sq. Ft.

Remarks



A technical service of Marsh & McLennan

Printed in U.S.A. Form WA-3-82-5.0

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

V. LOSS ESTIMATES

A. Probable Maximum Loss (PML)

The largest probable loss, property damage and business interruption which is expected, excluding catastrophic conditions, with normal protection faiclities or procedures failing or rendered inoperative but with secondary defences intact and functioning is estimated to be:

Property Damage: 20% of the Uranium Oxide Building or $10,000,000 based on a fire loss and possible furnace explosion.

Business Interruption: Downtime resulting foom the above is estimated at 6 months for repair and replacement of equipment.

B. Potential Third Party Liability:

The loss potential to third party properties is nil as the plant is well detached from other properties.

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

C. Maximum Possible Loss (MPL)

The largest loss, property damage and business interruption which is to be expected under adverse circumstances, not excluding catastrophic conditions and with protective equipment not functioning and damage limited only by spacing between major facilities or by blank fire walls is estimated at:

Property Damage: 40% of the Uranium Oxide Building or $20,000,000 based on a fire loss with possible explosions.

Business Interruption: The resulting downtime based on the above loss is estimated at one year of production loss due to time required for repairs and replacement of facilities.

EXXON NUCLEAR COMPANY, Inc.

600 - 108th Avenue N.E., C-00777, Bellevue, Washington 98009, Telephone (206) 453-4300

P. R. McMURRAY
President and Chief Executive Officer

February 29, 1984

Mr. P.G. Sikoris, P.E.
M&M Protection Consultants
240 Cedar Knolls Road
Cedar Knolls, NJ 07927

Ref: M&M Protection Consultants' Inspection Report of Exxon Nuclear Company's Richland, Washington Plant Site

Dear Mr. Sikoris:

We have completed our review and engineering studies of the recommendations contained in your inspection report dated August 31, 1983, prepared by Mr. J. Abrenica, covering the April 26-27 survey of our Richland, Washington facility.

Attached is our response to each of the 16 recommendations. We have completed or are in the process of completing eight recommendations and have taken or are taking alternative action on an additional four. Our engineering studies do not support further action being taken on the four remaining recommendations.

We apologize for the delay in responding to your recommendations, but needed time to study your report and complete our engineering assessments.

If additional information is needed, please contact R.H. Purcell, Manager, Safety & Security Operations on (509) 375-8460.

Sincerely,

P.R. McMurray

/jjm
Attachment

EXXON NUCLEAR COMPANY RESPONSE
TO M&M PROTECTION CONSULTANTS
APRIL 1983 SURVEY

Recommendation 83-1

a) Part 1 - "The existing automatic sprinklers at the inlet sections of the filter housing should be extended to cover the entire section occupied by the combustible filters."

Response: A detailed engineering evaluation indicates that extension of these fogging devices is not warranted. The risk of fire damage is small compared to the consequences of fan operation with high filter pressure drop caused by wet filters. No further action is planned.

Part 2 - "The existing control valves for the (deluge) systems should be either replaced with indicating type valves or kept sealed in the fully open position."

Response: We agree with your recommendation and have sealed the deluge system isolation valves in the fully open position.

b) "The trailers used temporarily for offices and storage should be relocated at least 50 feet away from the exhaust stacks and blower units."

Response: We agree with your recommendation. The trailers have been relocated.

Recommendation 83-2

"The local water department should be petitioned to improve the existing water supply at the south section of the plant by restoring the 10 inch supply section which reportedly was abandoned due to leaks in the system."

Response: Discussions were held with the City of Richland about restoring the line per your recommendation. No restoration activity is planned at this time; however the line should be upgraded in the future by the city. Exxon Nuclear Company reaffirmed that local safety and fire codes are being met. A risk analysis concluded that there is a very low probability of a major fire at a time when the north supply line is down and that additional investment by Exxon Nuclear in the south supply line does not appear to be justified. We believe that the best choice is to wait for the city to upgrade the line and to monitor its progress in this respect.

Recommendation 83-3

"The monthly inspection program should be improved by conducting drain tests on the sprinkler risers and checks on the control valves for the fire water lines."

Response: Alternative action has been taken in that the Grinnell Fire Protection Systems of Spokane is conducting semi-annual checks of the wet sprinkler system. Monthly checks of the supply valves in the fire water lines were added to the preventive maintenance system checks to insure that these valves are fully open.

Recommendation 83-4

a) "A concentration test should be conducted on the newly installed halon extinguishing system to verify that the system can provide the recommended 5-6% halon concentration."

Response: Alternative action has been initiated. The halon system design assumptions and calculations will be checked against the as-built facility. If ample system capacity is not available to provide the required concentration, the amount of halon in the system will be increased. This review will be completed by May 1, 1984.

In addition to the review, a program was initiated to control penetrations of the computer room walls.

b) "The existing trash cans [in the computer facility] should be replaced with self-extinguishing types."

Response: We agree with your recommendation. Self-extinguishing cans have been emplaced.

c) "Waterproof covers should be kept on hand [in the computer facility] for use in the event of an emergency and to minimize damages from accidental water discharge from the second floor area."

Response: We agree with your recommendation. Waterproof covers are now available in the computer facility.

Recommendation 83-5

"To minimize losses involving the outdoor propane storage tanks, an automatic water spray system is recommended. The water supply system should be activated either by heat actuated devices (HAD) or hydrocarbon gas detectors."

Response: An evaluation was made on the risk of tank penetration and a fire spreading between tanks. We found that this risk was low because of tank arrangements, bumpers installed around the tank area and the fire wall between the propane and anhydrous ammonia tanks. No further action is planned.

Recommendation 83-6

"Shredded paper should not be stored in the Air Handling Room 419 of Building No. 4. Signs indicating this are posted, however, the rule is not being followed."

Response: Alternative action was taken. A brief review concluded that short term storage in Room 419 was preferable to storage in the adjacent hall. The sign was therefore removed and any sacks of shredded paper are being removed at least daily.

Recommendation 83-7

"The [diesel] driven portable steam generator should not be operated in the warehouse building as this can provide an ignition source for combustibles in the area."

Response: We agree with your recommendation. This steam generator is now located outside the warehouse in its own shed.

Recommendation 83-8

"The electric dryer used to dry springs for the fuel rods is located next to Dip Tanks of acetone and alcohol [in the tube cleaning facility]."

Response: We agree with your recommendation. An oven was installed to replace the dryer.

Recommendation 83-9

"Flammable liquids in 5-gallon cans, consisting mostly of isopropanol, should not be stored or temporarily kept in the Motor Control Center and next to the main process control panels in the UO_2 Building.

Response: We agree with your recommendation and action is in progress. The flammable liquid storage cabinet will be relocated by March 15, 1984.

Recommendation 83-10

"The storage of paper supply in cartons next to the first story open stairway in Building #8 should be relocated to a separate storage room or area with sprinkler protection provided."

Response: Alternative action was taken. This paper supply is now stored in metal cabinets in accordance with instructions provided by the City of Richland Fire Marshal.

Recommendation 82-1

"Due to combustible construction and/or occupancy automatic sprinkler protection is recommended to minimize a serious fire loss in the following areas:

a) Building #5 of the office building complex.
b) Warehouse building.

Response: A careful evaluation was made of both areas. The facilities meet all applicable local fire and safety codes. The risk of a serious fire is very low and does not warrant the installation of sprinklers in either location. We will continue our present safety practices of maintaining the risk of loss as low as possible. No further action is planned.

Recommendation 82-3

"The undiked auxiliary generator diesel oil storage tanks located in the north and south equipment rooms of the UO_2 building should be provided with curbs or metal dikes and drains to a safe location."

Response: We agree with your recommendation. Installation of the dikes has been completed.

RICHLAND FIRE AND EMERGENCY SERVICES DEPARTMENT

Key Box____ Alarm # 749010 FIRE SAFETY SURVEY Line/Block# 20-1
# of Keys____ Functional____

Business Name EXXON NUCLEAR Address 2101 HORN RAPIDS ROAD Phone 375-8100

Manager BOB ERWIN Address (H)Phone

Bus. Owner EXXON NUCLEAR Address 2101 HORN RAPIDS ROAD (H)Phone 375-8100

Bldg. Owner " " Address " " " (H)Phone " "

#Stories__ Basement (yes) (no) Test Dates: Spklr. 12-13-85 AL 12-13-85 H & D____ Halon 12-13-85

S.P.____ Boilers (yes) (no) Fuel ELEC Last Test Date 3-84

	VIOLATIONS NOTED
1. EXITS: (a) maintenance (b) obstructions (c) approved hardware	
2. CORR./STAIRS/AISLES: (a) obstructed (b) fire resistance provided & Maintained	
3. EXIT ILLUMINATION/EM. LIGHTING: (a) adequate (b) functional	
4. EXIT SIGNS/OCC. LOAD SIGNS: (a) provided (b) visible (c) over crowding	
5. FIRE SEPARATIONS: (a) maintenance (b) protection of openings (c) operation	
6. HEATING APPL./EQ.: (a) clearances (b) condition (c) shut-offs	
7. ELECTRICAL: (a) haz. condition (b) ext. cords (c) motors/appl. condition (d) access	
8. COMB. STORAGE: (a) storage practices (b) eq. rooms (c) prohibited accumulation (d) fire retardant treatment	
9. HAZ. MATERIALS: (a) prohibited or excess quantities (b) unsafe practices	
10. NO SMOKING SIGNS: (a) required (b) compliance	
11. OPEN FLAMES: (a) unlawful (b) fire haz. (c) improper use	
12. PREMISES IDENTIFICATION: (a) provided (b) visible	
13. PORTABLE EXT.: (a) proper type (b) proper quantity (c) travel distance/location (d) proper checks Mo. Year	
14. SPKLR. SYSTEMS/STAND PIPES/HYD'S./FIRE DEPT. CONNECTIONS/ALARM SYSTEMS/HALON (a) test records (b) access (c) maintenance (last test date above)	
15. COMMERCIAL COOKING, HOOD & DUCT EXT. SYSTEMS: (a) proper coverage (b) fuel/power shut-offs (c) manual pull access (d) proper checks (last test date above) (e) cleanliness/operation instructions.	

VIOLATION NO.	DESCRIPTION OF VIOLATION NOTED ABOVE	TO BE CORRECTED BY	DATE CORRECTED
	Permit # 80-24		
	No violations noted at this time		

NOTE: Any overlooked hazardous condition and/or violation of fire codes does not imply approval of such condition or violation.

I have received a copy of this report and I am aware of the violations noted.

Owner/Manager/Employee Signature First Inspection

Owner/Manager/Employee Signature Second Inspection

INSPECTED BY: Ruzicka, Fabricant, Inspector SHIFT/STATION A-3 DATE 1-6-86

REINSPECTED BY:____ SHIFT/STATION____ DATE____

CHAPTER 11

ORGANIZATION AND PERSONNEL

CHAPTER 11 ORGANIZATION AND PERSONNEL

11.1 Organizational Responsibilities

It is the policy of Exxon Nuclear Company, Inc. to conduct its business in a manner so as to assure that its facilities are safe from radiation and other nuclear hazards; that its operations will not be detrimental to the environs and to assure that personnel (both in-plant and off-site) radiation exposures are maintained as low as is reasonably achievable (ALARA). In providing this assurance, conditions of applicable NRC licenses shall be complied with, and full regard shall be given to applicable NRC Regulatory Guides.

Responsibility for establishing and assuring adherence to this policy shall rest with the President of Exxon Nuclear Company, Inc., and exercised through the Vice President, Engineering and Production. This policy shall be implemented through appropriate delegations to managers responsible for particular facilities processing or otherwise handling radioactive and nuclear materials. Each responsible manager shall be required to know, understand and carry out the provisions of this policy and the procedures for its implementation.

11.2 Functions of Key Personnel

The organization at the corporate level are depicted in Figure II-9.1.

The function and responsibilities of the various safety-related positions are described in Chapter 2 with the flow of responsibility depicted by Figure I-2.1. During the absence of key individuals, another individual is delegated in writing to assume his responsibilities. In the case of a plant emergency, the Radiological Contingency Plan lists alternates to the Emergency Director.

11.3 Education and Experience of Key Personnel

Resumes of personnel who currently occupy key safety-related positions are listed hereunder.

11.3.1 President and Chief Executive Officer - S. J. Beard

Education

BA	Chemistry	1952	University of Minnesota
BS	Chemical Engineering	1954	University of Washington
MS	Management	1969	Mass. Institute of Technology

Washington State Professional License - Chemical Engineering

Experience

1954-1965

Various capacities in the nuclear industry at the Hanford Atomic Products Operation (HAPO) with General Electric Company under a prime contract to the AEC.

1965-1968

Manager, Processing Engineering. Responsible for developing the technology supporting the Hanford Waste Management Program at Hanford.

1969-1971

- Manager, Operations Support Engineering Department of the Atlantic Richfield Hanford Company. Responsible for engineering support to the Government's Production Facilities in the Hanford 200 areas--1969-1970.
- Manager, Manufacturing Department of the Atlantic Richfield Hanford Company. Responsible for operation of Government's Production Facilities in the Hanford 200 areas--1971.

1972-1976

Manager, Fuel Reprocessing Engineering for Exxon Nuclear Company, Inc. Responsible for development of the plant process and the design of Exxon Nuclear's Nuclear Fuel Recovery and Recycling Center.

1977-1978

Manager, Fuel Cycle Services and Reprocessing Department for Exxon Nuclear Company, Inc. Responsible for support services to utilities, engineering, and fabrication of fuel storage racks and for fuel reprocessing studies.

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1979-1980

General Manager, Laser Enrichment Department of Exxon Nuclear Company, Inc. Responsible for development of laser enrichment technology and design of JNAI's Experimental Test Facility.

1981

Vice-President, Engineering and Technology.

1982

Vice-President, Marketing and Uranium Operations.

1986

Executive Vice-President.

1986

President and Chief Executive Officer.

11.3.2 Vice President, Engineering and Production - R. W. McCullugh

Education

BS	Industrial Management	1951	Carnegie Institute of Technology, Pittsburg, PA

Experience

1951-1967

Employed by General Electric Company, Richland, WA (Hanford Project) in several managerial positions:

- Employed in various capacities including industrial engineering, supervision of reactor fuel assembly, production planning and scheduling--1951-1958.
- Managed a Relations Practices Section which included employment, Industrial Safety and Communication--1959-1961.
- Managed Purex Processing Operation (irradiated nuclear fuel processing) which included operations direction, process control, and radiation monitoring services--1961-1965.
- Managed Redox Plant (irradiated nuclear fuel processing) which included operating activities of the UO_2 plant as well. Responsibility included operations, maintenance, analytical control laboratory, radiation monitoring, process control, product quality, and industrial and nuclear safety--1965-1967.

1967-1968

Employed by Isochem, Inc., Richland, WA as Manager, Technical Services which included analytical control, laboratory services and radiation monitoring support for the Purex, UO_2, Plutonium Finishing, and Waste Management plants.

1968-1970

Employed by Atlantic Richfield Hanford Company, Inc., Richland, WA as Manager, Purex Plant which included responsibility for operations, maintenance and engineering support activities.

1970-Present

Employed by Exxon Nuclear Company, Inc., Richland, WA, and has served in various managerial positions:

- Managed Materials & Purchasing which included shipping and receiving of nuclear materials and maintaining custodial control of nuclear materials not under control of operations managers. Also included assuring that plant inventories of nuclear materials did not exceed authorized possession limits--1970-1979.

- President and Chief Executive Officer for Exxon Nuclear Idaho Company (ENICO) , Idaho Falls, Idaho. The President, ENICO, is responsible for the overall management of the separation of enriched uranium in irradiated reactor fuels. Within this responsibility were the safety related functions of operations, process and equipment engineering, maintenance, materials handling and storage, and industrial, radiation, and criticality safety--1979-1981.

- Assigned to Exxon Nuclear Company, Bellevue, Washington, as Manager, Corporate Affairs. Responsibilities included Finance, Law, Tax and Public Affairs--1981-1982.

- Assigned to present position of Vice President, Engineering & Production, in April 1983. Responsibility includes all engineering and production activities conducted at Exxon Nuclear facilities at Richland, Washington and Lingen, West Germany. Safety related management responsibilities include industrial, environmental, radiation and criticality safety.

11.3.3 Manager, Operations-Richland - R. G. Frain

Education

BS Industrial Administration 1963 Villanova University

Experience

1960-1967

Employed by General Electric Company in various progressively responsible positions in manufacturing.

1967-1968

Employed by Polyphase Instruments Company as production manager.

1968-1975

Employed by General Electric Company as Senior Engineer for business development studies related to gas centrifuge uranium enrichment, and as Manufacturing Project Engineer assigned to Goddard Space Flight Center for installation and startup of the ground data handling system for the earth resources satellite.

1975-Present

Employed by Exxon Nuclear Company, Inc. as Manager, Malta Operations, which was developing centrifuge manufacturing capability.

- Manager, Shop Operations-Richland--1980.
- Managing Director of Exxon Nuclear European affiliate, ENGmbH--1980.
- Manager, Operations-Richland--1983.

11.3.4 Manager, Plant Operations - M. K. Valentine

Education

BS	Chemical Engineering	1969	Montana State University
MBA	Business Administration	1974	University of Idaho

Experience

1969-1972

Employed by Idaho Nuclear Corporation at Idaho Falls, Idaho as a Research Engineer in the Planning and Cash Flow Analysis section. Activities included:

- Long range planning of fuel reprocessing activities, conceptual design of process improvements/budget planning, and preparation of funding packages for major new additions for presentation to the AEC.
- Development of a computer program simulating nuclear fuel reprocessing operations, integrating new processes and cash flows.
- Conceptual design, program management, and preparation of a safety analysis report for a neptunium purification, recovery and packaging process.

1972-1977

Employed by Allied Chemical Corporation at Idaho Falls, Idaho as a Senior Research Engineer in the Process Technology Branch. Activities included:

- Pilot-plant development of a reprocessing method for the High Temperature Gas-Cooled Reactor Program.
- Development of a fluidized-bed method for classifying microspheres of nuclear fuel particles from HTGR fuel and assisted in the development of a fluidized-bed graphite burner for the same program.
- As Supervisor of the Safety Analysis Group of the Operational and Environmental Safety Office, activities involved the preparation of a safety review document covering all aspects of the multiple-headend Idaho Chemical Processing Plant, nuclear fuel reprocessing facility. Supervision of three other chemical engineers in preparing the SAR. The analysis included detailed process and equipment descriptions, fault-tree analysis, consequence analysis, and environmental impacts.

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1977-Present

- Joined Exxon Nuclear Company, Inc., as Plant Chemical Engineer in July 1977.
- Promoted to Manager, Maintenance Engineering in November 1977.
- Promoted to Manager, Process and Maintenance Engineering in March 1979.
- Transferred to Manager, Fuel Testing in December 1982.
- Promoted to Manager, Operations Planning and Scheduling in July 1983.
- Promoted to Manager, Plant Operations in January 1985.

II.3.5 Manager, Safety and Security Operations - R. H. Purcell

Education

BS	Chemical Engineering	1949	University of Colorado
MS	Chemical Engineering	1950	University of Colorado
MBA	Business Administration	1964	University of Washington

Experience

1950-1972

Employed by General Electric Company and Battelle Northwest in various reactor research and development activities.

- Chemical Engineer in reactor coolant chemistry--1950-1956.
- Supervised mechanical component testing group--1956-1959.
- At Plutonium Recycle Test Reactor as Process Engineer and Supervisor, Process Technology--1959-1969.
- Managed deactivation of PRTR--1969.
- Engineering Associate in fuel fabrication quality assurance--1969-1972.

1972-Present

Joined Exxon Nuclear as Senior Quality Control Engineer in January 1972.

- Senior Quality Control Engineer--1972-1973.
- Supervisor, Process Control--1973-1975.
- Supervisor, Quality Control Engineering--1975-1977.
- Manager, Accountary Operations[1]--1977-1981.
- Manager, Production Control--1981-1983.
- Assigned to present position in July 1983.

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1 Former title of Safety and Security Operations.

11.3.6 Manager, Plant Maintenance - J. L. Glesener

Education

Technical courses completed:

- Electronic Technician School, U.S. Navy
- Instrument Technician Apprentice Program
- Reactor Training for Maintenance Supervision
- Certified Vibration Analyst
- Codes and Standards for Fabrication of Nuclear Power Piping and Vessels
- High Vacuum Systems and Helium Leak Detection
- Basic Data Processing

Experience

1951-1955

Electronics Technician in the U.S. Navy.

1955-1972 (Prior to Exxon Nuclear Company, Inc.)

Employed at Hanford, Washington by General Electric Company, Battelle Northwest and Westinghouse Electric Company in the following positions:

- Instrument Technician, 300 Area Hanford, six years.
- Specialist, Scheduling and Methods, Craft-Reactor Maintenance (all crafts), six years.
- Foreman, Multi-Craft Reactor Maintenance, 1-1/2 years.
- Acting Manager, PRTR, Reactor Maintenance, six months.
- Specialist, Planning and Scheduling for FFTF related Sodium Facilities Maintenance and Fabrication, two years.

Other related experience during this period included:

- Administered all Craft Apprenticeship Programs for Battelle Northwest and Westinghouse, two years.
- Advisory Committee, Columbia Basin College Electronic Technology Program, four years.
- Industrial Representative for Washington State Office of Vocational Education, two years.

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1972-Present (Exxon Nuclear Company, Inc.)

- Supervisor, Rod Finishing, UO_2 Operations--1972-1973.
- Manager, Plant Maintenance--1973-Present.
- Administration of all Richland site maintenance services.
- Member of Plant Emergency Cadre since 1972.
- Member of ALARA Committee since 1980.

11.3.7 Supervisor, Radiological and Industrial Safety - T. C. Probasco

Education

BS	Microbiology	1970	Oregon State University
BS	Military Science	1970	Oregon State University

Certification

Certified Safety Professional	1982	Board of Certified Safety Professionals

Experience

1970-1972

Highway Engineering Technician for the Oregon State Highway Department.

1972-1975

Employed by a food processing company. Supervised chemical and bacteriological laboratories in quality assurance department--1972-1973.

Safety Engineer--1973-1975.

1975-Present

Joined Exxon Nuclear as Plant Safety Engineer in December 1975. Assigned duties as Plant Criticality Safety Engineer in December 1976 after training period of one year.

Assigned duties as Supervisor, Radiological and Industrial Safety in January 1985. Responsible for supervising Health Physics Technicians, plus Radiological Safety Specialist and Industrial Hygiene Specialist.

11.3.8 Industrial Hygienist and Plant Criticality Safety Engineer - S. R. Lockhaven

Education

BA Biology	1974	Central Washington University
BA Environmental Studies	1976	Central Washington University
Various Industrial Hygiene Training Courses		1979-Present

Experience

1976-Present

Joined Exxon Nuclear as a Senior Analytical Laboratory Technician in 1976. Assigned to Industrial Hygienist position in 1979. Duties also included scheduling environmental sampling, environmental data review and assisting Plant Criticality Safety Engineer.

Assigned additional duties as Plant Criticality Safety Engineer in 1986.

11.3.9 Health Physics Technician - D. L. Belt

Education

High School Diploma	1954	Columbia High School
	1975	Columbia Basin College
Radiation Protection Training (80-hour course)	1977	Battelle Northwest

National Registry of Radiation Protection Technologists - Preparatory Training Classes (12 week course/year)--1979, 1980, 1981, 1982

Other Education/Training

- Engineering Laboratory Techniques
- Radiation Control Practices
- Theory of Power Plant Operation
- Radiography Techniques
- Dosimetry
- Radiation Shielding and Radioactive Material Containment
- First Aid Training
- Annual First Aid Refresher Courses--1977-1986
- Annual Plant Emergency Cadre Training--1977-1986

Experience

1975-1977

Joined Exxon Nuclear Company as a Technician in the UO_2 fuel fabrication operation.

1977-Present

Assigned as a Health Physics Technician at Exxon Nuclear's Horn Rapids site and Research and Technology Facility.

Overall experience at Exxon Nuclear includes nine years background in nuclear safety field as Health Physics Technician. Responsible for overall auditing, inspection, monitoring and evaluating health physics-related criteria. The application of procedures used in the control of radiation, radioactive materials and criticality are also functions of this position. Responsible for auditing, recognizing and evaluating radiological and nuclear hazards and/or taking emergency action as necessary to protect health and property. Additional responsibilities of this job include training of new employees, maintaining records of bioassay, personnel monitoring and survey results,

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exposures, room air and exhaust sampling and monitoring. Daily audits are performed of compliance to State and NRC license conditions. Daily air sampling, and analysis of same of all areas of the plant. Responsible for environmental monitoring, H_2O sampling of waste lagoons obtaining environmental (fluoride and vegetation) samples within a 10-mile radius of plant. Also included as major responsibilities of this position are recordkeeping, issuing reports and entering data in computerized Environmental Monitoring Program.	

11.3.10 Health Physics Technician - J. D. Cudmore

Education

High School Diploma	1946	Washburn, Wisconsin
Industrial Welding/Burning (100 hours)		Ashland Vocational School Ashland, WI
General		Columbia Basin College
U.S. Army Airplane School (3 mo. school/12 mo. training)		Nara, Japan
Business courses (33 hours)		Northland College Ashland, WI

Technical courses completed:

- Elementary Nuclear Physics
- Ionizing Radiation Measurements
- Air Sampling Principles and Evaluations
- Shipments of Radioactive Materials
- Radiological Civil Defense
- Mathematics in Radiation Protection
- Radiation Protection Techniques
- Radioactive Decontamination Principles
- Radiation Exposure Records
- Disaster Monitoring

Experience

1953-1971

Worked in Richland, WA in the following capacities related to radiation protection:

- Worked for one year as a Chemical Technician. Assisted chemists and engineers in operation of the radioactive hot cell liquid waste solidification techniques. Knowledge of chemistry, chemical tank makeup, vacuum and pressure, control rod instruments and manipulation of the same. Also filled, shipped and received radioactive samples and liquid casks. Complete knowledge of decontamination of equipment large and small, including personnel.

- Four years experience as a manipulator-operator. Experience in Am, Pu, Pm, Cs, Ce, Np, Sm separation and purification using ion exchange columns and glovebox techniques.

- Made radiation surveys of radiation zones and non-radiation zones, report and recommend corrections for unsatisfactory conditions. Made surveys and authorize release of equipment. Prescribe dose rates and clothing requirements for entry into radiation zones and for work within these zones in contaminated equipment and radioactive material. Investigate the circumstances leading to clothing or skin contamination or uncontrolled contamination spread. Prescribe the necessary respiratory protection after taking air samples and evaluation. Provide either constant or intermittent monitoring of radiation zone work. Made legible, concise, accurate and complete records of all activities. Provide radiation protection training to operating and maintenance personnel.

1971-Present

Joined Exxon Nuclear in December 1971 as a Health Physics Technician.

11.3.11 Radiological Safety Specialist - E. L. Foster

Education

High School Diploma 1960 Richland, Washington

Attended Columbia Basin College evening classes in Engineering Drawing and Algebra. Completed Chemistry class in Radiation Technician's course before program was discontinued.

Nuclear Weapons Technician School completed while in U.S. Air Force. School lasted 26 weeks.

Technical courses completed:

- Radiation Dosimetry
- Biological Effects of Radiation
- Radioactive Waste Disposal
- Environmental Monitoring
- Elementary Nuclear Physics
- Mathematics in Radiation Protection
- Ionizing Radiation Measurements
- Radiation Protection Techniques
- Air Sampling Principles and Evaluations
- Radioactive Decontamination Principles
- Radiation Exposure Records
- Disaster Monitoring

Experience

1967-1971

Employed at Richland, WA as a Radiation Monitor. Gained professional experience in the development and application of health physics programs for radioactive chemical separations plants, multicurie laboratory operations and nuclear fuel manufacturing.

Pertinent accomplishments were:

- Three years of work experience in various plutonium facilities; performed monitoring duties during major cleanup and modification of plutonium hot cells and gloveboxes.

- Direct participation in surveillance of effluent from plutonium facilities while assigned to an Environmental Monitoring group.

- Direct participation in setting up routine health physics program for PRTR.

- Completed special assignment involving modification of plant air monitoring program.

1971-Present

Joined Exxon Nuclear in March 1971 as a Health Physics Technician. Became involved with all phases of Radiological Safety program throughout entire plant site.

Technician Specialist in Radiological Safety--1977.

Radiological Safety Assistant--1980.

Radiological Safety Specialist--1985.

Since 1984 have served as Radiation Safety Officer for Washington State license.

Presently responsible for implementation of radiological safety training program, dosimetry program, bioassay program, writing of Radiation Work Procedures, reporting of radiological conditions to plant supervision.

Completed training course in Respiratory Protection at Nuclear Power Plants--1985.

Completed training course for Radiation Safety Officer--1986.

11.3.12 Health Physics Technician - D. A. Marlin

Education

High School Diploma	1950	Selah, WA
Chemical, Biological and Radiological School	1952	Gifu, Japan
Radiation Monitoring Training Programs	1954-1970	Richland, WA
Radiation Technology	1964-1966	Columbia Basin College
Electrical Appliance Repair	1969	Richland, WA

Experience

1954-1973

Employed at Richland, Washington in the following capacities related to radiation monitoring:

Provided radiation protection for personnel in the Hanford laboratory divisions consisting of constant scientific experiments, storing contaminated liquid waste, and disposing of extremely high radiated and contaminated solid waste. Provide routine and special surveys to promote contamination and exposure control.

As a Radiation Monitoring Journeyman, provided radiation monitoring for all crafts needed to maintain and operate both the graphite reactors and a dual-purpose power reactor.

As a Radiation Monitoring Supervisor, supervised the activities of radiation monitoring journeymen during reactor operations and shutdown. Scheduled and assigned this manpower to various jobs with consideration to the requirements of job safety, labor costs, radiation exposure control and coordination with operating and maintenance groups.

Provided radiation protection for personnel in all phases of operations and maintenance in nuclear reactors. Provided routine and special survey to promote contamination and exposure control. Advise on requirements, procedures, and optimum methods for accomplishing work, including shielding, decontamination and remote operations. Collected and analyzed data for use in determining present and future needs in radiation protection.

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Provided radiation protection for tank farm personnel. Burying radioactive liquid waste and processing waste to remove different elements in each process until waste was made into a hard state.

In conjunction with tank farm work, covered laboratory work dealing with sampling radioisotopes in gloveboxes and hoods. Provided control of radiation exposure by monitoring and using preventive shielding methods and keeping areas clean by constant smearing and monitoring with survey instruments.

1973-Present

Joined Exxon Nuclear in August 1973 as a Health Physics Technician.

11.3.13 Health Physics Technician - J. Rosscup

Education

High School Diploma	1954	Glasgow, MT
	1975-1976	Columbia Basin College Pasco, WA
Health Physics Technician Training	1978	
Advanced First Aid Training Course	1979	

Experience

1976-Present

Joined Exxon Nuclear in 1976 as a technician in the UO_2 fuel fabrication operation. Assigned as a Health Physics Technician in February 1978.

11.3.14 Health Physics Technician - W. W. Smith

Education

High School Diploma	1956	
Radiation Technology	1984	Golnick Home Correspondence
NRRPT Cert. Course	1985	University of Washington Richland, WA

Advanced and Basic First Aid (currently certified)

Experience

1980

Two years experience, actual monitoring - Exxon.

Four years experience, radiation-related work - Exxon

11.3.15 Health Physics Technician - G. A. York

Education

High School Diploma	1970	Walla Walla, WA
	1970-1971	Western Washington State College, Bellingham, WA
	1977-1978	Walla Walla Community College Walla Walla, WA
Hanford Radiation Monitor Training Program (26 weeks)	1979	
	1981-1983	Columbia Basin College
NRRPT Cert. Course	1985	

Experience

1979-Present

Joined Exxon Nuclear in October 1979 as a Health Physics Technician.

11.3.16 Manager, Materials and Scheduling - I. J. Samaritano

Education

BChE	Chemical Engineering	1960	Polytechnic Institute of New York
MSChE	Chemical Engineering	1962	Rensselaer Polytechnic Institute
Industrial Administration		1970-1973	Union College Schenectady, NY

Licenses/Memberships

Licensed Professional Engineer, New York

Licensed Professional Engineer, Nuclear Branch, California

Member, American Institute of Chemical Engineers

Experience

1960

Joined the General Electric Company at the Knolls Atomic Power Laboratory as a Design Engineer. Areas of increasing responsibility included reactor performance analysis, reactor accident analysis, reactor primary shield design, and in-reactor corrosion and crud buildup on nuclear fuel elements. Responsibilities included computer analysis, design, implementation, and analysis of test loop experiments and experiments in operating nuclear reactors. As a supervising engineer, responsible for the hydraulic design of the reactor for a nuclear powered aircraft carrier.

1970

Joined the General Electric Steam Turbine Department as a Unit Manager of Shop Operations with responsibilities for a manufacturing unit of 250 machinists engaged in the precision machining of major components for large steam turbine generators. Both nuclear and fossil design steam turbines were fabricated. Responsibilities included management of daily operations, training of personnel, scheduling utilization of equipment, production control planning, and material utilization.

1973

Joined the General Electric Research Laboratory of the General Electric Corporate Research and Development Center as a Chemical Engineer responsible for the development of a process for the separation of uranium isotopes using high performance centrifuges.

1974

Joined the Exxon Nuclear Company at Malta, NY as a Senior Manufacturing Engineer responsible for developing equipment, plant layouts, and facility design and staffing plan for the manufacture of high performance centrifuges to be used for isotope separation. In this capacity, supervised the architect engineer and produced a complete plant design including associated cost estimates.

1976

Assigned increased responsibilities as a Project Manager for Marketing, Contract Administration, Manufacture, and Testing of high performance centrifuges and components utilized in the U.S. Department of Energy Centrifuge Demonstration Program.

1980

Appointed Manager, Production and Inventory Control at Exxon Nuclear's Fuel Fabrication plant in Richland, WA. Responsible for plant scheduling and control of all material inventory utilized for producing fuel, determining required quantities and assuring material availability. Responsible for formulating requirements for an advanced computer system to fully control both material supply and actual production. Also responsible for employee training utilizing the new system. This sophisticated computer system was successfully implemented.

1983

Assigned additional responsibilities as Manager, Materials and Scheduling with full responsibility for planning, procuring, and managing all material requirements. In addition, full responsibility for all plant scheduling, production control activities including work station sc' eduling, receiving, warehousing, and international shipping and traffic.

11.3.17 Manager, Operations Planning and Scheduling - D. C. Lehfeldt

Education

BS	Industrial Engineering	1954	Montana State University
BS	Mechanical Engineering	1954	Montana State University

Experience

1954-1965

Employed by General Electric Company at Hanford:

- Manufacturing engineering on fuel fabrication for production reactor and N-Reactor--1954-1962.
- Supervisor, Equipment Development and Maintenance Engineering, N-Reactor Fuels. Involved with plant equipment and maintenance programs--1962-1965.

1965-1972

Employed by Battelle Northwest, Richland, WA:

- Senior Engineer on isotope source fabrication, recycle fuel equipment, Pu-Al plate type fuel development and fueled shim rods--1965-1966.
- Manager, Radiometallurgy, involved with personnel, equipment and facilities in the examination of irradiated fuels and materials--1967-1969.
- Manager, Nuclear Fuels, involved with development and fabrication of UO_2, MOX and graphite fuels--1969-1972.

1972-Present

Employed by Exxon Nuclear Company, Inc., Richland, WA:

- Senior and Staff Engineer involved with materials and hardware specifications and procurement for power reactor fuels, project coordination and contract administration--1972-1984.
- Manager, Operations Planning and Scheduling, involved with planning and scheduling fuel fabrication activities and logistics for national and international shipments of fuel hardware materials and for waste shipments--1985-Present.

11.3.18 Manager, Process and Equipment Engineering - H. L. Caudill

Education

BS Chemical Engineering 1959 Montana State University

Experience

1948-1964

- Joined the General Electric Company (GE) at Richland, Washington and worked in general stores and inventory control, and also as an operator of nuclear materials processing equipment--1948-1959.

- Rejoined GE after receiving an engineering degree, and held several positions of increasing responsibility in engineering of nuclear facilities. This experience included conceptual facilities design, detailed design review, construction management, and operations startup--1959-1964.

1964-1971

- Joined Isochem, Inc. when it assumed the contracts for operating the chemical processing facilities at Richland (Hanford). Joined Atlantic Richfield Hanford Company when it assumed the same contracts--1964-1966.

- In various managerial positions, responsibilities included performing conceptual and detailed design of nuclear facilities and for providing analytical and radiation monitoring services in support of plant operations--1966-1971.

1971-1985

- Joined Exxon Nuclear Company, Inc. and was initially responsible for project engineering support in the conceptual design of a commercial nuclear fuels reprocessing plant--1971-1974.

- Reprocessing Project Manager directing the efforts of Bechtel, Inc., under contract to Exxon Nuclear, in conducting a preliminary design of Exxon Nuclear's proposed Nuclear Fuel Recovery and Recycling Center. This facility included irradiated fuel storage and chemical reprocessing. Also responsible for the mechanical development of reprocessing head-end equipment--1974-1979.

- Manager, Design and Mechanical Development in the Laser Enrichment Department of Exxon Nuclear, responsible for the design and testing of mechanical equipment used for enriching uranium using lasers. Later responsible for the conceptual design of a proposed commercial laser enrichment production facility--1979-1981.

- Appointed Vice President, Projects, Exxon Nuclear Idaho Company (ENICO), and was responsible for all design and construction projects conducted by ENICO under contract to the U.S. Department of Energy at Idaho Falls--1981-1985.

- Appointed Manager of the Process and Equipment Engineering Department which provides engineering and corporate licensing services to Exxon Nuclear's fuels fabrication facilities located in Richland, Washington and Lingen, West Germany.

11.3.19 Manager, Process Support Engineering - R. B. McLees

Education

BS	Ceramic Engineering	1959	Clemson University
MS	Ceramic Engineering	1960	Clemson University

Experience

1960-1969

Development Engineering at Y-12 Plant, Oak Ridge, TN - Engaged in materials research and development.

1969-1975

Equipment Engineer at General Electric BWR plant, Wilmington, NC - Equipment installation and startup.

1975-1976

Staff Engineer at General Atomic Plant, San Diego, CA - Liaison with A/E on design of HTGR fuel fabrication plant.

1976-Present

- Equipment Engineer at Exxon Nuclear Company, Inc., Richland, WA for one year.
- Supervisor, Chemical Conversion Operation, one year.
- Lead Engineer, Incremental Plant Expansions, three years.
- Project Engineer, 550 MTU Plant Expansion and Lingen Pelletizing Project, four years.
- Manager, Process Support Engineering--1985.

11.3.20 Manager, Facilities and Equipment Engineering - S. G. Harbison, P.E.

Education

BS Mechanical Engineering 1952 Mississippi State College

Professional Engineer

Nuclear Engineer License No. NU000582, State of California

Experience

1952-1962 (Non-Nuclear)

Served as Lieutenant (Communications Officer) in U.S. Air Force and worked as a Mechanical Engineer for Westinghouse Electric Corporation, The Austin Company, and Thiokol Chemical Corporation.

1962-1977

- Employed by Aerojet - General Corporation on various nuclear programs:
- Project/Design Engineer - NERVA Nuclear Rocket Program from 1962 to 1965.
- Project Management - Radioactive maintenance systems/equipment for high temperature gas-cooled reactor, FFTF fuel handling and radioactive maintenance, LMFBR shipping cask, nuclear fuel reprocessing plant headend mechanical systems, LMFBR large valve development, experimental loop handling equipment for nuclear test facilities, systems/equipment for nuclear fuels/materials examination facilities, and radioactive filter handling equipment for commercial nuclear power plants--1965-1977.

1977-1984

Employed by U.S. Department of Energy, San Francisco Operations Office, Oakland, CA in various management positions:

- Director of the Nuclear Energy Division--1977-1979.
- Director of the Nuclear and Magnetic Fusion Division--1979-1982.

- Assistant Manager for Defense Programs (senior executive service position). Responsibilities included Defense Program Management, Safeguards and Security Division, Laser Projects Office (NOVA laser fusion and special isotope separation), and the Lawrence Livermore National Laboratory site office--1982-1984.

1984-Present

Joined Exxon Nuclear Company as Manager, Equipment and Methods Engineering in June 1984. Assigned as Manager, Facilities and Equipment Engineering in October 1985. This position is responsible for contributing to the fabrication and production of nuclear fuel through administration and management of Equipment, Maintenance, Development and Methods Engineering activities directed toward effective support of manufacturing operations, and through management and direction of Design/Drafting support for all engineering activities in the Engineering and Production Division.

11.3.21 Manager, Chemical and Ceramic Development - R. E. Felt

Education

BS	Chemical Engineering	1958	University of Idaho
MS	Chemical Engineering	1959	University of Idaho
PhD	Chemical Engineering	1964	Iowa State University

Experience

1964-1966

Employed by General Electric as a Development Engineer in plutonium fabrication processes.

1966-1967

Continued as an engineer in plutonium process development and related areas as contract was shifted to Isochem, Inc.

1967-1977

Transferred to Atlantic Richfield Hanford Company. Staff Engineer in Plutonium Process Engineering--1967-1973. Manager, Plutonium Process Engineering, Product Process Engineering, and Separations Process Engineering--1973-1977.

1977-1978

Transferred to Rockwell Hanford Company as Manager of Engineering Development Laboratory.

1978-Present

Joined Exxon Nuclear as Manager of Chemical Engineering in the Research Department (1978-1981). Manager, Process Engineering, responsible for process control, process technical support, and new process and equipment development (1981-1985).

Currently Manager, Chemical and Ceramic Development, responsible for process development in the chemical, ceramic and waste processing areas.

11.3.22 Manager, Corporate Licensing - C. W. Malody, Jr.

Education

AB Chemistry 1950 University of Kansas

Experience

1950-1963

Employed by General Electric Company, Richland, WA.

- Process Control Engineer. Process engineering included responsibilities for operating procedures, flowsheet testing, devising process control programs for control of product purity and nuclear safety and plant technical support.
- Manager, Uranium Oxide. Responsibilities included operation, maintenance and radiation monitoring.

1963-1964

Employed by Isochem, Inc., Richland, WA.

- Manager, Uranium Oxide.
- Manager, Purex Operations. Responsibilities included plant operations, process control and radiation monitoring.

1964-1977

Employed by Atlantic Richfield Hanford Company, Inc., in several managerial positions:

- Manager, Process Control Engineering. Responsibilities included process control, nuclear safety control, process test authorization and direct technical support to the Purex Plant--1964-1968.
- Manager, Technical Services. Responsible for $5 million annual budget and approximately 230 employees in three process control laboratories and radiation and monitoring control--1968-1970.
- Manager, Purex Plant. Responsible for annual budgets greater than $10 million and managed approximately 160 employees in operations, maintenance, process engineering and radiation monitoring--1970-1973.

- Manager, Production Department. Responsible for annual budgets greater than $25 million and managed more than 700 employees in three major processing operations, maintenance, process engineering and radiation monitoring--1973-1976.

- Manager, Production and Waste Management. Directly responsible to the President for the overall direction of 1,200 employees and more than $40 million annual operating budget. Member of Company's negotiating team during union contract renewals. Also member of five-man Executive Council determining Company priorities and resource allocations--1976-1977.

1977-Present

Employed by Exxon Nuclear Company, Inc., Richland, WA and has served in various positions:

- Consultant. Responsibilities included providing consulting services in support of the proposed Exxon Nuclear reprocessing and spent fuel storage programs--1977-1979.

- Manager, Process Engineering. Responsibilities included keeping abreast of research and development activities in the field of reprocessing. This was accomplished by maintaining contact with and providing supporting studies for those DOE sites involved in the back end of the fuel cycle such as ORNL, Sandia, Idaho Falls, etc.--1979-1981.

- Manager, Licensing and Compliance, Operating Facilities. Responsibilities included all licensing activities and criticality and radiological safety programs for the fuels fabrication plant and research laboratory--1981-1985.

- Manager, Corporate Licensing. Responsibilities include overall licensing and regulatory responsibility for Exxon Nuclear's fuel production and transportation activities, and for defining, administering and auditing Exxon Nuclear health physics, environmental surveillance, ALARA, nuclear criticality safety, and nuclear material safeguards programs for facilities located in Richland, WA--1985-Present.

11.3.23 Criticality Safety Engineer - L. D. Gerrald

Education

BS	Chemical Engineering	1967	University of South Carolina
MS	Chemical Engineering	1971	University of South Carolina

Experience

1968-1971

Employed by Westinghouse Electric Corporation at the nuclear fuel fabrication plant at Columbia, SC. Responsible Process Engineer for the startup and operation of the UF_6-UO_2 conversion process lines.

1971-Present

Employed by Exxon Nuclear Company, Inc., at the nuclear fuel fabrication plant at Richland, WA.

- Process Engineer responsible for pellet fabrication process for approximately three years.
- Process Development Engineer responsible for numerous studies related to several fuel fabrication processes for approximately five years.
- Process Engineer responsible for the ceramic part of the Sphere-Pac project. Developed equipment and parameters for drying and sintering the UO_2 spheres to be used. Also developed continuous-flow vertical sintering furnace for this process.
- Developed computer codes for calculcting pore size distributions for pellets using scanning electron microscope and image analyzer.
- Responsibility as primary Criticality Safety Analyst started in March 1983. Converted several SCALE modules (KENO, XSDRN, BONAMI, NITAWL) to Exxon Nuclear computer systems. Responsible for verification of codes and cross sections. Numerous major criticality safety analyses were performed for operations at Exxon Nuclear-Richland, Exxon Nuclear-Lingen, West Germany, and for fuel storage racks for power reactors. Analyses have also been performed for submittal to the USNRC Transportation Certification Branch.

11.3.24 Specialist, Health Physics - J. E. Pieper

Education

BS Nuclear Eng. Technology	1973	Oregon State University
Conditional Operator Cert.	1972	BWR Power Plant Training Center

Experience

1973-1976

Employed by Aerojet Nuclear Company at Idaho Falls, ID and involved in the following activities:

- Design engineering (4 months).
- Nuclear technology (4 months).
- Nuclear (criticality safety program, analyses and training) and environmental safety (approximately 2-1/2 years).
- MORT Management Oversight and Risk Tree--1974.

1976-1980

Employed by Rockwell Hanford Operations at Richland, WA in the following activities:

Nuclear safety--1976-1977.

- Criticality safety program appraisal.
- Review of criticality safety analyses and procedure, and system designs.
- Radiological safety inspections and audits.

Health, Safety and Environment function representative to the Chemical Processing, Waste Encapsulation and Fractionalization programs--1978.

Health, Safety and Environment Design Review Coordinator--1978-1980.

- Safety review and approval of new projects and designs.
- Technical consultant on DOE requirements for packaging and shipping radioactive materials.

- Flying Tigers Hazardous Materials Shipping Seminar and Workshop--1979.

Radiological Engineer in the Decontamination and Decommissioning Program--1980.

1981-Present

Employed by Exxon Nuclear as a Licensing Engineer responsible for assuring compliance with the health physics requirements of the license for a uranium fuel fabrication facility and performing criticality analyses in support of the facilities operation.

- Internal Radiation Dosimetry--1983
- Introduction to Power Reactor Health Physics--1983
- Health Physic Certification Preparation--1983,1985,1986
- Biokinetics and Analysis of Uranium in Man--1984
- Radioactive Materials Training Course (DOT)--1984
- Internal Do.. Assessment--1985

11.3.25 Specialist, Nuclear Materials Safeguards - R. A. Schneider

Education

BS Chemistry and Mathematics	1949	Seattle University
5-Year Secondary Education Cert.	1950	Seattle University
MS Chemistry	1957	University of Idaho

Experience

1950-1967

Sixteen (16) years of combined professional and management experience in the nuclear industry. Technical areas include nuclear materials safeguards research and development, analytical chemistry research and development, separation processes, and applied analytical chemistry. Contributor and team leader of a number of projects aimed at establishing nuclear materials measurement methods and in determining the reliability of measurement systems. Directed development efforts for the measurement and recovery of by-products of spent reactor fuels. Manger of Analytical Laboratories responsible for operational aspects of industrial and radiological safety and for criticality safety of the plutonium laboratory.

1967-1976

Team leader of Battelle Northwest's nuclear materials safeguards research and development effort. Contributions include various safeguards systems studies, the development of independent methods of verification, and definition of systems needs. Author of the Pu/U ratio method of input accountability to a chemical processing plant, the "Cesium Index" method for coating waste, and a principal developer of the use of isotopic correlations for verifying the plutonium content of spent power fuels. Regular lecturer at the Argonne Safeguards School. Published extensively in Analytical Chemistry, the Institute of Nuclear Materials Management, and in Hanford formal reports. Consulted for the IAEA, the USACDA and NRC.

1976-Present

Joined Exxon Nuclear in March 1976 as Senior Specialist, Nuclear Materials Safeguards, with principal responsibility to assist in formalizing Exxon Nuclear corporate policies in the area of safeguards and to prepare the Exxon Nuclear Safeguards Development Program.

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Current responsibilities include designation as accountability coordinator for safeguards and as main working level liaison contact with NRC. Other safeguards responsibilities include acting measurement control program coordinator and Exxon Nuclear director of safeguards courses conducted for international safeguards. Professional qualification now include election to the rank of Fellow in the first group elected by the Institute of Nuclear Materials Management in 1984.	

11.3.26 Manager, Fuel Engineering and Technical Services - G. L. Ritter

Education

BA	Chemistry	1961	Pacific Lutheran University
BS	Chemical Engineering	1962	University of Washington
MS	Chemical Engineering	1964	University of California

Experience

1964-1965

Employed by General Electric as a Process Engineer at the Hanford Purex Plant and Semiworks Facility.

1966-1968

Employed by Isochem, Inc. as a Senior Process Engineer responsible for developing the technology to recover fission products (Cesium-137, Strontium-90, Technetium-99 and Promethium-147) from Hanford high level liquid wastes.

1968-1971

- Employed by Atlantic Richfield Hanford Company as a Senior Engineer responsible for defining and planning Hanford research and development programs for managing radioactive wastes--1968-1970.
- Manager, Separations Process Engineering, responsible for process control and process development support of the Hanford Purex plant.

1971-Present

- Joined Exxon Nuclear as a Senior Engineer in June 1971 as a Senior Engineer responsible for portions of the technology to support a proposed commercial reprocessing plant-1971-1973.
- Manager, Reprocessing Process Engineering, responsible for all process technology and safety analyses for the commercial reprocessing plant project--1973-1977.
- Manager, Reprocessing Engineering, responsible for engineering activities to support reprocessing projects performed for the Department of Energy and Oak Ridge National Laboratories--1977-1979.

- Vice President, Technical Department, responsible for all technical activities for supporting the Idaho Chemical Processing Plant at the Idaho National Engineering Laboratory--1979-1981.

- Manager, Process and Engineering Development, responsible for process engineering and R&D for Exxon Nuclear's Fuel Fabrication Plant at Richland--1981-1983.

- Manager, Process and Equipment Engineering, responsible for all process and project engineering support for the Fuel Fabrication Plant--1983-1985.

- Manager, Fuel Engineering and Technical Services, responsible for nuclear fuel management, licensing and in-core monitoring. Also responsible for Fuels Research and Development and Corporate Computer Services--1985-Present.

11.3.27 Manager, Fuel Research and Development - K. N. Woods

Education

BS	Materials Science	1962	Stanford University
MS	Metallurgical Engineering	1963	University of Michigan
PhD	Materials Science	1968	Northwestern University

Experience

1969-1972

Employed by General Electric's Corporate Research and Development Center in Schenectady, NY. Performed basic research on ceramic material.

1972-1977

Employed by General Electric's Nuclear Fuel Department in Wilmington, NC. Managed advanced process development in a large UO_2 fabrication plant. Included responsibility for UF_6 to UO_2 conversion, UO_2 pelletizing, and liquid waste stream treatment.

1977-Present

Joined Exxon Nuclear as Manager, Fuel Performance in March 1977.

- Assigned expanded responsibility as Manager, Fuel Performance and Process Development--1979-1982.
- Manager, Research--1982-1984.
- Manager, Fuel Research and Development--1984-Present.

11.3.28 Manager, Fuel Development and Testing - J. F. Patterson

Education

BS	Mechanical Engineering	1952	Colorado State University
MS	Nuclear Engineering	1957	University of Michigan

Experience

1952-1954

Employed by Phillips Petroleum Company in the Materials Testing Reactor Department as a Design Engineer.

1957-1963

Employed by Allis-Chalmers in the Nuclear Power Department as Supervisor of Mechanical Engineering.

1963-1972

Employed by Westinghouse Electric Corporation in the Advanced Reactors Division as Manager of Mechanical Development, and PWR Systems Division as Manager of Reactor Mechanical Development.

1972-Present

Employed by Exxon Nuclear Company as Manager, Mechanical Engineering, and recently as Manager, Fuel Development and Testing. Responsible for the development of new fuel assembly designs, and also for thermal-hydraulic and mechanical testing for reload fuel.

11.3.29 Manager, Materials Research - R. A. Busch

Education

BS	Metallurgical Engineering	1961	Rensselaer Polytechnic Institute, Troy, NY
MS/ PhD	Materials Science	1963-1966	University of California

Post Doctoral Fellowship, UC (six months)

Experience

1966-1979

Employed by Battelle Northwest as a Senior Research Scientist in the Metallurgy Department with responsibility for contract R&D programs sponsored by government and industry. Major portions of effort in coating deposition/characterization and actinide elements.

1979-Present

Joined Exxon Nuclear Company in May of 1979. Currently Manager of Materials Research with responsibility for materials aspects of fuel and cladding development and characterization including laboratory work with nuclear materials.

11.4 Operating Procedures

Plant operations are conducted according to written procedures. The procedures are written by the Manager, Plant Operations, or his designee. They are approved by the Manager, Plant Operations, Quality Control, Facilities and Equipment Engineering, and Process Support Engineering. These procedures include, by reference, appropriate Criticality Safety Specifications, Radiation Work Permits, and other safety-related or pertinent documents or procedures. The procedures are documented and issued by Document Control to appropriate personnel and locations. There are mini-libraries located within the various operating facilities which contain copies of the approved operating procedures for ease of access by operating personnel.

11.5 Training

11.5.1 Initial Training

Each employee is provided initial instruction adequate to allow them to safely start on-the-job training by his/her manager or supervisor. This initial instruction includes emergency procedures. If the employee routinely works with special nuclear material, radiation protection and criticality safety requirements and procedures will be included.

Within two weeks after starting work, full instruction in Standard Operating Procedures (including instrumentation and control, methods of dealing with process malfunctions, control of hazardous chemicals, control of contamination and decontamination procedures), industrial safety, fire protection, emergency response procedures, radiation protection (including ALARA practices, nature and source of radiation, interactions of radiation and matter, biological effects of radiation, and the use of radiation monitoring equipment and step off pad procedures), and criticality safety requirements and procedures will be provided. The degree of training is commensurate with each employee's position in the company (related to general and special responsibilities) and with the extent of the employee's contact with radioactive and fissionable materials. Employee instruction is provided by personnel knowledgeable in the various training topics.

Prior to assignment to independent operation, each employee is required by signature to indicate that he has been instructed in radiation protection, criticality safety, and emergency response requirements and procedures.

11.5.2 Followup Training

When changes are made to processes involving special nuclear materials, radiation protection procedures, criticality safety controls (procedures, specifications, limits, etc.) fire protection, or emergency response procedures, each employee affected is promptly informed and properly instructed by his/her manager or supervisor.

Additionally, each employee who routinely works with special nuclear material receives annual refresher instruction as part of Exxon Nuclear's continuing program in radiation protection and criticality safety awareness. This training is provided by radiological and nuclear safety personnel knowledgeable in the various training topics. The effectiveness of this annual refresher training is determined by giving the employees a written examination and reviewing the correct answers to the questions at the end of the test.

All employees routinely discuss safety topics in monthly or quarterly scheduled safety meetings.

11.5.3 Emergency Response Training

Training in operating plant fire extinguishers is offered to all employees on an annual basis.

Plant Emergency Response Team members are trained in incipient fire fighting techniques, advanced first aid, self-contained breathing apparatus training in a smoke-filled environment, and radiological incident stabilization techniques on an annual basis.

Semiannual training is provided to all employees in the proper response to a criticality accident when a preannounced criticality evacuation drill is conducted.

11.6 Changes in Procedures, Facilities and Equipment

11.6.1 Facility and Equipment Changes

Changes in Facilities and Equipment involving licensed material are accomplished through application of the Engineering Change Notice (ECN) procedure. This procedure provides the instructions for authorizing and documenting the installation of new equipment, facilities and services and modifications to existing equipment, facilities and services.

11.6.1.1 Scope - Included

The ECN procedure is used when the work involved meets one or more of the following conditions:

- Affects the basic principles of operation of the manufacturing process.
- Directly involves fissile material.
- Affects criticality or radiological safety.
- Impacts industrial health and safety.
- Affects product quality.
- Involves licensing matters.
- Affects environmental protection.
- Requires a process building wall penetration.
- Requires underground work.
- Affects manufacturing plant equipment layout.
- Requires municipal building permit and/or fire marshall inspection.

11.6.1.2 Scope - Excluded

ECN's are not required for normal maintenance, repair or direct component replacement. ECN's are not required for minor changes which do not meet any of the above criteria.

11.6.2 Review

Prior to preparation of an ECN, the drawings and scope package are reviewed by a group made up of the Supervisor, Radiological and Industrial Safety, the responsible engineer, a representative of Maintenance, and a representative of Operations. The group reviews the design package for industrial safety and health, radiological safety and criticality safety problems. Changes arising from the review are implemented prior to ECN routing. Verification of review and implementation of necessary changes is indicated by sign-off of the ECN by members of the review group.

11.6.3 Control/Documentation

The ECN form and any excavation or penetration forms included in the package are edited for completeness and assigned a number by the Design and Drafting Clerk. The ECN title and number is recorded in the ECN logbook and a permanent file established in the ECN record file.

11.6.4 Review/Concurrence/Approval

The ECN receives but one approval - that by the User/Operator Manager. Prior to that approval however, several other managers have reviewed and concurred with the package. Following sign-off by the review group, the ECN package is routed in accordance with the Approval and Responsibility Matrix (Figure I-2.2).

11.6.5 Execution

Work begins upon receipt by either Maintenance or the Construction Engineer of copies of the fully approved ECN package issued by the Design and Drafting Clerk.

11.6.6 Acceptance

For projects not involving fissile material, acceptance of the work is documented by signatures of the project engineer, the Manager, Plant Maintenance, and the affected manager.

For projects involving fissile material, a physical review of the installation is made prior to introducing fissile material by a Criticality Safety Review team consisting of the Supervisor, Radiological and Industrial Safety, the Licensing Specialist - Criticality Safety, and the project engineer.

The Supervisor, Radiological and Industrial Safety, documents the team's approval by signing the ECN form.

11.6.6.1 Startup Council

A separate overview of certain projects is provided by a Startup Council prior to acceptance and operation of facilities, services, and equipment which have incurred significant change. Projects requiring Startup Council review are:

- Those having impact on production.
- Those with new safety issues or implications.
- New major projects (facilities/operations).
- Others as determined by the Chairman.

Membership of the Council consists of:

- Chairman: Manager, Process and Equipment Engineering
- Vice Chairman: Staff Engineer, Process and Equipment Engineering
- Secretary: Manager, Facilities and Equipment Engineering

- At Large: Manager, Operations-Richland
  Manager, Corporate Licensing
  Manager, Quality Assurance
  Manager, Plant Operations
  Manager, Safety and Security
  Manager, Materials and Scheduling
  Manager, Equipment and Maintenance Engineering
  Manager, Process Support Engineering
  Responsible Operations Manager
  Startup Coordinator (usually Project Engineer)

Startup Council concurrence is required for system operation; however, final authority for approving actual startup rests with the Responsible Operations Manager.

11.6.6.2 Acceptance Test

If an acceptance test is required prior to turnover of the facility, system or equipment to the operating group, acceptance of the work is accomplished via an Acceptance Test Procedure (ATP). The ATP is signed off prior to performance by the responsible engineer, the Manager, Plant Maintenance, the Supervisor, Radiation and Industrial Safety, the responsible engineer's manager, and the Manager, Operations-Richland. Final acceptance is then documented by signatures of the responsible engineer, his/her manager, the Manager, Plant Maintenance, and the affected Operations manager.

11.6.7 Records

The ECN record file is maintained by the Design and Drafting Clerk. Included in completed files are: the original ECN, a set of detailed drawings, specifications, applicable excavation and penetration permits, copy of any Criticality Safety Evaluation requests, and the completed ATP. Copies of safety, hazard and criticality safety analysis are maintained by the project engineer and/or the person performing the analysis.

11.6.8 Procedure Changes

The ECN procedure is prepared and maintained by the Manager, Equipment and Maintenance Engineering (E&ME). It is periodically reviewed for effectiveness and revised as necessary.

CHAPTER 12

RADIATION PROTECTION

CHAPTER 12 RADIATION PROTECTION

12.1 Program

Exxon Nuclear shall maintain radiation exposure as far below the limits specified in 10 CFR 20 as is reasonably achievable by establishing and maintaining a radiation protection program including:

- Written policy guides, standards and procedures
- Design, installation, and maintenance of facilities and equipment to the ALARA commitment
- Personnel training
- Access controls
- Exposure limit planning and control (this includes routine review of incurred radiation exposures)
- Surveillance and monitoring of personnel adherence to established procedures and of radiological conditions
- Radioactive effluent and waste control
- Use of protective clothing and personnel protective equipment (including respiratory protection)
- Inspections and audits
- Recordkeeping

12.2 Posting and Labeling

Radioactive material, airborne radioactivity, radiation and high radiation areas, as defined by 10 CFR 20, are identified and their boundaries are visibly marked. Signs denoting these areas are placed so that at least one sign is visible from any approach.

12.3 External Radiation - Personnel Monitoring

A personnel monitoring program has been established. The program consists of the following:

1. Establishment of external exposure limits including internal company guidelines which are lower than NRC limits.

2. Providing of dosimeters to measure the exposure of personnel.

3. Reading of the dosimeters by an outside contractor.

4. Analysis and maintenance of exposure records.

The occupational exposure received by Exxon Nuclear employees and visitors shall not exceed the NRC limit. Company guidelines have been established at less than the NRC limits in order to prevent overexposure. Procedures are in place for emergency exposures and increases in occupational external radiation exposures per 10 CFR 20.101(b). Exxon Nuclear must be informed of past exposure history before the first entry of an individual into a radioactive material area where exposure will, or is likely to, exceed 25 percent of the NRC limit in a quarter. All employees are advised of the National Council of Radiation Protection and Measurements recommendation to keep radiation exposure to an embryo or fetus to the very lowest practicable level during the entire gestation period.

All persons entering a radioactive materials area shall wear an individual beta/gamma sensitive dosimeter. This TLD has a range of 10 mrem to 1,000 rem beta/gamma. Other types of dosimeters such as finger rings and direct-reading dosimeters are used where the standard TLD's cannot provide the desired information or are not practical. Self-reading pocket dosimeters (pencils) may be used with x-ray operations or where external radiation exposures have the potential for exceeding company guides in a matter of days.

Radiation exposure dosimeters are analyzed at least quarterly for personnel working in areas where they have the potential to exceed 25 percent of the quarterly company exposure guide. Finger rings are processed monthly and pencils read weekly and readings are documented. The TLD's of personnel working in areas where they do not have the potential to exceed 25 percent of the quarterly company guides are analyzed at least annually. All reading of dosimeters, except for direct-reading dosimeters, is done by the U.S. Testing Company.

Dosimetry results are evaluated by Radiological and Industrial Safety personnel to determine that external exposures of personnel at the Richland Fuel Fabrication Plant are within limits. The exposure data is also reviewed by the ALARA Committee to determine the effectiveness of programs to maintain exposure as low as reasonably achievable.

12.4 Radiation Surveys

The routine radiation survey program consists of the following:

1. A detailed survey of the radiation levels is performed during the initial startup of each operation and each storage area involving radioactive material. These surveys provide the necessary information for determination if the area must be classified as a radiation area and the necessary boundaries of such an area. It also identifies areas where ALARA modifications may be necessary.

2. Monthly radiation surveys are performed in all areas where radioactive materials are processed or stored and where personnel have access. These surveys identify areas where the radiation status has changed and potential areas for ALARA modifications.

3. Radiation surveys are performed on all incoming and outgoing shipments of radioactive materials to assure that the shipment conforms to applicable regulations of the Nuclear Regulatory Commission, the U.S. Department of Transportation, the U.S. Post Office Department, the State of Washington Utilities and Transportation Commission, and the International Atomic Energy Agency. Detailed procedures are in place to assure that necessary radiation surveys are performed on all receipts and shipments of radioactive material.

Special radiation surveys are performed when applicable to determine radiation levels for maintenance and other activities. Surveys may be taken before the start of the work to permit evaluation of methods to reduce exposures during the work. Surveys are also performed at the start of the job to confirm the radiation levels present and if necessary during the work to assure that levels have not increased substantially. With few exceptions, radiation levels are low and the equipment may be opened to permit direct readings to be taken without any mechanical difficulties being encountered. Careful preplanning is conducted and special procedures are prepared, if necessary, when high radiation levels will be encountered.

12.5 Reports and Records

All reports and records of the Radiation Protection Program, required in Part I, Section 2.8 of this application, shall be maintained in company files in accordance with 10 CFR 20.401. Such reports and records are maintained for a minimum period of five years unless the NRC specifies longer retention periods for specific records.

12.6 Instruments

The criteria for selecting radiation measurement instruments for performing radiation and contamination surveys, sampling airborne radioactivity and monitoring area radiation are described in Part I, Table I-3.1 of the license application.

The Manager, Safety and Security Operations, is responsible for maintaining adequate quantities of radiation measurement instruments and related equipment.

The Manager, Plant Maintenance, is responsible for the maintenance and calibration of radiation safety instruments and equipment. The following general requirements apply to all such equipment and instruments:

1. All radiation detection instruments are inspected, repaired when necessary, and calibrated at least semiannually.

2. Instruments are calibrated following any maintenance on them before they are put back into routine service.

3. Each on-line radiation detection instrument is checked for proper operation by Health Physics Technicians daily (Monday through Friday). When daily checks are performed in a manner which qualifies as calibration, separate semiannual calibrations are not required.

4. Portable survey instruments are source checked each time they are turned on for use.

5. AC-operated personnel contamination survey instruments are provided with individual check sources to allow personnel to source check the instruments at random intervals.

6. Calibration sources are traceable to the National Bureau of Standards.

7. Dose rate instruments are inspected, repaired and calibrated at least quarterly.

8. Instruments used to measure the quantity of radioactivity emitted in gaseous effluents are calibrated at least monthly and source checked weekly.

12.7 Protective Clothing

The types of protective clothing required for operating personnel in normal, maintenance and accident conditions is dependent upon the work assignments and the levels and types of contamination present and is specified in the applicable Exxon Nuclear Company's Radiation Work Procedures which govern those conditions.

For inspection type activities lab coats and cotton or rubber shoe covers may suffice perhaps supplemented with cotton glove and surgeons cap. Most normal operating and maintenance assignments will require rubber shoe covers, full coveralls, and surgical type rubber gloves or light weight PVC gloves. For more unusual type operations or maintenance full cotton hoods and cotton boots may be required. Industrial type safety equipment is also available such as face shields, goggles, and acid suits. In addition both half mask and full face negative pressure respirators as well as positive pressure full face respirators are available.

12.8 Administrative Control Levels (Including Effluent Control)

The action levels, alarm set points, frequency of measurements and actions to be taken for the various radiation protection monitoring programs are as follows:

12.8.1 Occupational Exposure (Internal and External)

The bioassay program including frequency of measurements for determining internal exposure, is described in Section 12.12. The routine urinalysis results and in vivo results are reviewed by the Health Physics Component of Corporate Licensing and by Radiological Safety to determine any unusual trends or potential exposures. If the internal exposure of an individual appears uncertain additional analyses and/or removal from further exposure will be considered.

The external exposure personnel monitoring program including frequency of measurements was described earlier in Section 12.3. The quarterly dosimeter results are carefully reviewed by Radiological Safety personnel to determine any unusual trends or exposures. If the external exposure status of an individual becomes uncertain the individual is removed from further exposure and the Supervisor, Radiological and Industrial Safety, determines the exposure status and advises supervision of any special controls or restrictions to be applied.

12.8.2 Airborne Activity

The gaseous effluent controls are described in Section 5.1. The stack action levels are listed in Table I-5.1. The samples are counted by a single channel analyzer utilizing a surface barrier detector. The lower level of detection varies with the stack being sampled and ranges from 1.4×10^{-15} uCi/ml to 3.5×10^{-14} uCi/ml for 3 wt% enriched uranium based upon a seven-day sampling period. The lower level of detection for mixed fission and activation products is 7.2×10^{-14} uCi/ml, also for a seven-day sampling period.

The action levels specified in Table I-5.1 include shutdown requirements to reduce emissions. In the event that the calculated dose to any member of the public in any consecutive 12-month period is about to exceed the limits specified in 40 CFR 190.10, the company will take immediate steps to reduce emissions as to comply with 40 CFR 190.10.

The area air sampling program is discussed in Section 12.13.

12.8.3 Liquid Activity (Effluent Monitors)

Liquid effluent leaves the site at the south boundary and is discarded to the municipal sewer. This effluent is sampled continuously and a composite sample is analyzed each work day for uranium and regulated chemicals. The amount of uranium is determined fluorometrically with a minimum detection level of 0.1 ug/ml (0.1 ppm) uranium. Action levels are to investigate any sample result greater than 0.1 ppm and to shutdown the processes which could discharge uranium upon a confirmed sample result greater than 1.0 ppm.

There is a potential for discharge of uranium to the groundwater by leakage from the process chemical waste storage lagoon system. The system between the liner sampling system and the action levels are described in Section 5.1.3.1. The groundwater test wells and sampling programs are described in Section 5.2.2. Action levels are based primarily on the regulated chemicals for resampling and investigation although all data are reviewed and any significant change investigated.

12.9 Respiratory Protection

The primary objective of Exxon Nuclear's respiratory protection program is to limit the inhalation of airborne radioactive materials and other harmful air contaminants, to comply with permissible exposure limits, and to protect employees in oxygen-deficient atmospheres. This objective is normally accomplished by the application of engineering controls, including process, containment, and ventilation equipment. When such controls are not feasible or cannot be applied, the use of respiratory protective equipment may be appropriate. In general, however, the use of respirators is less desirable in

providing respiratory protection then is the use of process, containment, and ventilation techniques. The use of respirators as a substitute entails both greater likelihood of accidental exposures and greater likelihood that such exposures may go undetected. It might also subject the wearer to additional stress and increase the individual's risk of injury by interfering with his/her vision, freedom of motion, and ability to communicate. The provision and use of respiratory protective equipment is subject to the following considerations regarding circumstances under which respiratory protection may be needed.

Routine operations are planned activities that are generally repetitive and occur with various frequencies. For such operations, potential sources of airborne radioactive materials and other harmful air contaminants or oxygen deficient atmospheres will be identified so that respiratory protection may be accomplished by the use of process, containment, and ventilation measures and by preplanning of work. The use of respirators as a substitute for practicable engineering controls in routine operations is inappropriate. Respirators may be considered for use, however, while engineering controls are being instituted or evaluated.

Nonroutine operations are activities that are either nonrepetitive or else occur so infrequently that adequate limitation of exposures by engineering controls is impractical. To the extent that process, containment, and ventilation controls are not reasonably feasible in nonroutine operations, the use of respirators to avoid excessive exposure to airborne radioactive materials and other harmful air contaminants or oxygen-deficient atmospheres is appropriate.

Emergencies are unplanned events characterized by risks sufficient to require immediate action to avoid or mitigate an abrupt or rapidly deteriorating situation. Although emergencies are unplanned, preparations must be made for coping with potential emergencies. Our preparations properly include a program for providing necessary and sufficient respiratory protection for use in potential emergencies that are likely to entail respiratory hazards. The advance preparations appropriate to a particular potential emergency will depend on both its possible consequences and the probability of its occurrence. (See XN-NF-32, Emergency and Radiological Contingency Plan, for further details on plans for dealing with emergencies.)

Most operations can be readily categorized as "routine", "nonroutine", or "emergency". However, a few activities might be difficult to assign to one category or another. In dealing with these situations, sound judgment must be exercised in providing and using engineering controls where feasible and by avoiding unwarranted use of respirators.

The periods of time respirators are worn continuously and the overall durations of use should each be kept to a minimum. It is necessary to allow respirator users adequate relief from wearing respirators at reasonable intervals and to limit total time to use. However, it is difficult to realistically

assign specific time limits on respirator use because of wide variations in job requirements and in the physical capacities and psychological attitudes of individuals. Such factors must be taken into account in establishing a respirator program. Provision is made for the respirator users to leave "on mask" areas for relief in case of equipment malfunction, undue physical or psychological distress, procedural or communication failure, significant deterioration of operational conditions, or any other condition that might require such relief.

The respiratory protection program meets the requirements of several State and Federal regulations, standards and guides (Washington Administrative Code 296-62-071, Occupational Safety and Health Administration 29 CFR Part 1910.134, NRC 10 CFR 20.103, NRC NUREG-0041, NRC Regulatory Guide 8.15, and American National Standards Institute Z88.2-1980).

12.10 Occupational Exposure Analysis

Occupational Exposure analysis has been performed and documented in the form of an annual ALARA Report. The ALARA Report for 1985, XN-NF-86-39, Rev. 0, is appended at the end of this chapter. It contains a history of external and internal exposure data in Tables II and V. These tables include estimates of dose based on airborne contamination, in-vivo (lung count) data and urinalysis. Trend evaluation is discussed in Section 3.0. Measures taken to further minimize personnel dose are presented in Section 4.0.

12.11 Measures Taken to Implement ALARA

Exxon Nuclear has committed to maintaining a functioning ALARA (As Low As Reasonably Achievable) Committee as a subgroup of the Health and Safety Council. The membership and activities of this committee are outlined in Section 2.3.2. Company policy in this area is outlined in Section 3.1.1. A copy of our most recent ALARA report is attached as Appendix A to this chapter.

12.12 Bioassay Program

The bioassay program established by Exxon Nuclear is normally conducted to confirm the results of radioactive material contamination control and room air monitoring programs and to detect unsuspected intakes of radioactive materials. However, it also may used to estimate internal exposures due to internally deposited radioactive material.

The frequency and type of measurement is established on the basis of the exposure potential of the individual's work assignment and the physical and biological properties of the radioactive material with which he works.

PART II - SAFETY DEMONSTRATION

REV.

Radiation exposure due to internally deposited radioactive materials shall be kept as low as in reasonably achievable by the implementation of engineering controls, along with administrative and precautionary procedures.

The following guides apply to the bioassay program.

1. Employees routinely working in contaminated area containing soluble uranium submit monthly urine specimens for uranium analysis.

2. Employees routinely working in contaminated area containing insoluble uranium shall receive in-vivo examinations at least annually.

3. If the most recent quarterly average of the airborne uranium concentration for any work area exceeds 25% of the respective DAC, the frequency of sampling and the type of bioassay measurements for workers in that work area shall be modified to that given in Table 3 of Regulatory Guide 8.11, "Application of Bioassay for Uranium," June 1974.

   Unusual occurrences with documented evaluation will not be included in calculating the quarterly average. However, diagnostic evaluations, as defined in Section C.2.b(4) of Regulatory Guide 8.11, shall be performed in accordance with criteria set forth in Figure 2 of the same Guide.

4. Individuals shall be reexamined when bioassay results are as follows:

   c. For soluble uranium compounds, an individual whose urine specimen exhibits a concentration in excess of 25 micrograms uranium/liter is required to submit another urine specimen on his first work day following the Company's receipt of the result, and at least weekly thereafter until a concentration of less than 25 micrograms uranium/liter is reached.

   b. For insoluble uranium, should the future dose commitment to an individual's lung (based on in-vivo examinations) exceed 7.5 rem for the following 12 months, that individual will receive in-vivo examinations at least bi-monthly as long as he continues to work in contamination control areas, and until that time when the future dose commitment to the lung for a subsequent 12-month period is less than 5 rem.

   Any time that a dose evaluation is necessary, an investigation as to the possible source and cause shall be jointly conducted by the Supervisor, Radiological and Industrial Safety and the Health Physics Component of Corporate Licensing.

5. Individuals shall be restricted from work in contamination control areas when bioassay results are as follows:

   a. For soluble uranium compounds, any individual whose urine specimen exhibits a concentration in excess of 100 micrograms uranium/liter; such individuals shall not be allowed to work in contaminated area until subsequent urine specimens exhibit a concentration of less than 25 micrograms uranium/liter.

   b. For insoluble uranium, any individual whose future dose commitment to the individual's lung (based on in-vivo examinations) exceeds 12 rem for a subsequent 12-month period; such individuals shall not be allowed to work in contaminated areas until that time when his future dose commitment to the lung for a subsequent 12-month period is less than 7.5 rem.

12.13 Air Sampling and Internal Exposure Program

The air in all areas where uncontained radioactive materials are handled, processed, or are likely to exist, is regularly sampled, and the samples are analyzed for radioactivity. The air sampling system is a flexible combination of equipment and instruments. Field-run lines (flexible or hard-piped) connect individual air samplers to the overhead vacuum lines such that the samplers may be moved about and located at any desirable point without causing obstructions or creating industrial safety problems. Some samplers are located at points of maximum airborne contamination potential, some are located at points representative of the contamination level of air breathed by personnel at work stations, and some are located so as to provide background data.

The filter papers of the sampling units representative of air breathed by personnel are exchanged and analyzed at least daily (Monday through Friday). Some samples may be exchanged and analyzed more frequently in the event of a known or suspected elevated airborne contamination, or to assess the effectiveness of radioactive material containment following equipment modification or maintenance, or to assess the air quality of sequential shift operations.

Permanently mounted air sampling equipment used to determine the workers' breathing zone concentrations is evaluated for representativeness at least every 12 months, and following significant process or equipment changes.

Specialized air sampling or monitoring equipment such as continuous air monitors, portable high volume air samplers, and lapel air samplers are available to supplement the normal air sampling system, and for use in studies or work on special problems.

Air sample counting instruments are checked for proper operation each workday and background values are determined.

Exxon Nuclear shall maintain radiation exposures as far below the normal limits specified in 10 CFR 20.103(a) as is reasonably achievable.

Respiratory protective equipment will be used for entry into areas where airborne radioactive materials exist in excess of the concentration that stated in 10 CFR 20.203(d)(ii).

12.14 Surface Contamination

Radioactive materials are contained and/or confined during processing, transfer and storage to the extent of maintaining intake of such materials by personnel as low as reasonably achievable. As appropriate, operations involving readily dispersible forms of radioactive materials are accomplished within enclosures (i.e., process equipment, glove boxes, glove-port hoods, laboratory type hoods, etc.) which are exhausted to facility exhaust air systems.

Facility Surveys. A detailed survey of contamination levels is performed for each specific operation involving radioactive material when the operation is initiated, and frequently thereafter for a period of time, dependent on demonstrated operational controls as reflected in survey results. Operations involved in the production of fuel are repetitive in nature, equipment and systems employed in development activities are normally similar to those used in the production facilities, and the containment and confinement principals are employed consistently throughout Exxon Nuclear's facilities, thus making it possible to effectively establish routine and repetitive contamination surveys. The frequency of routine surveys is determined by a combination of professional judgment and experience, and are periodically reviewed by the Health Physics Component. In general, reduced frequencies are permitted when the stability of an operation, as demonstrated by the consistency of survey results and the relationship between observed values and operational controls is established. However, the following minimum frequency schedule is applied to the facility contamination survey program:

Contaminated Radioactive Materials Area	Weekly
Noncontaminated Radioactive Materials Areas	Monthly
Intermediate Areas	Daily
Lunchrooms Adjacent to Radioactive Materials/Radiation Areas	Daily

Operational controls are considered adequate for uranium operations when the following conditions prevail:

1. No visible (smearable) contamination on exposed or nonhooded surfaces in the process areas (not applicable to non-routine tasks being conducted under special controls).

2. No smearable contamination on exposed or nonhooded surfaces in the process areas in excess of 10,000 dpm (alpha) per 100 cm^2 (not applicable to nonroutine tasks being conducted under special controls).

3. No smearable contamination on intermediate area floors in excess of 500 dpm (alpha) per 100 cm^2.

4. No smearable contamination in clean areas in excess of 200 dpm (alpha) per 100 cm^2 and no fixed contamination greater than 2,000 dpm (alpha) per 100 cm^2.

Uranium contamination in excess of the levels specified in 1, 2, 3 and 4 above are cleaned up when detected.

Release of Personnel, Materials, Equipment, Facilities and Shipments. Contamination surveys are performed on all personnel leaving contaminated areas, on all materials, equipment and facilities to be released from radiation protection requirements, and on all incoming and outgoing shipments of radioactive materials.

1. Personnel. Contamination surveys are conducted according to the following schedule:

   a. All persons leaving contaminated areas are required to survey themselves for contamination with survey instruments located at respective step-off areas after removing protective clothing and prior to leaving the step-off area.

   b. Personnel are not released to eat or leave the respective facility if their personal clothing is contaminated in excess of the following limits, except with the approval of the Supervisor, Radiological and Industrial Safety and the respective facility manager:

Smearable:	200[1] dpm (alpha) per 100 cm^2
Fixed Uranium:	2000 dpm (alpha) per 100 cm^2

1 200 dpm (alpha) per 100 cm^2 represents the practical lower detection level for most direct-reading contamination survey instruments.

c. For routine release, personnel skin surface contamination shall not exceed 200 dpm (alpha) per 100 cm^2.

2. Materials, Equipment and Facilities. Contamination surveys are performed by Health Physics Technicians on all materials and equipment removed from contaminated areas, and on areas or facilities to be released from radiation protection requirements. Decontamination of facilities and equipment prior to release for unrestricted use or termination of license shall be in accordance with Annex C (Appendix A of Chapter 3).

3. Shipments of radioactive materials arriving at the facility are surveyed to the requirements of 10 CFR 20.205. All outgoing shipments of radioactive materials are packaged and surveyed in accordance with 10 CFR 71 and 49 CFR 173.443.

APPENDIX A

CHAPTER 12

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1985 ALARA COMMITTEE REPORT

Prepared by

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March 1986

EXXON NUCLEAR COMPANY, INC.

1985 ALARA COMMITTEE REPORT

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1985 ALARA COMMITTEE REPORT

1.0 INTRODUCTION

This report is submitted to the Industrial Health and Safety Council in accordance with the requirements of License SNM-1227. The objectives of this report are to:

1) Determine trends in personnel exposure or effluent releases.

2) Determine if existing equipment and procedures for radioactive effluent and exposure control are being properly used, maintained and inspected.

3) Determine if personnel exposure or radioactive effluents might be reduced under the concept of as low as reasonably achievable (ALARA).

The above objectives are accomplished by review of employee external and internal exposure data, unusual occurrence reports, effluent/environmental data and plant environmental trends.

2.0 SUMMARY

1) There was a slight increase in gaseous discharges to the environment compared to 1984; however, the discharge remained below that of 1982-83. There were no increasing trends in effluent releases to the environment.

2) The average external exposure decreased in 1985 and the total man-rem continued it's declining trend.

3) The average airborne uranium contamination continued to decline during 1985. Although the average declined there are a few individual work stations that have averaged over the company guide.

4) There was a slight decrease in the lung exposure estimated by lung counting data. A slight increase occurred in the man-rem estimated from urinalysis sampling. This increase appears to be due to a loss of quality control by the contracting lab that performs the analysis and was determined not to be an increasing trend in personnel exposure.

5) There were no unusual occurrences. Audits by the NRC and Corporate Licensing verified that existing equipment and procedures for radioactive effluent and exposure control are used and maintained to assure personnel exposure is as low as reasonably achievable.

3.0 TREND EVALUATION

3.1 Radioactive Effluent Discharges

3.1.1 Liquid

Liquid discharges from ENC's Horn Rapid site to the environment during 1985 were monitored at the Exxon Nuclear/City lift station. A new waste effluent station was put into use in September 1985. These data are reported by Table I. Throughout the year all monthly samples taken from the station were consistently below our lab's lower limit of detection of less than 0.1 ppm uranium (0.16 nanocurie/liter). Based on the analyzed value and the volume discharged, the radioactive discharge was conservatively calculated to be less than 0.08 curie (8% of the one curie limit allowed by 10CFR20).

The only known source of uranium to the sewer system is the waste discharged from Lagoon 5A. This is a small flow and is normally measured at being above our lab's lower limit of detection. There are proportional sampler and volume measurement instruments located in the ammonia recovery building that are used to sample and measure the Lagoon 5A to sewer stream.

The Lagoon 5A discharge is used by Nuclear Material Accountability for their nuclear material transaction report (NRC Form 741) as our only source of uranium discard in liquid effluents. To be consistent with the nuclear material accountability reports and to provide more accurate data, future uranium discharges listed in this report will be based on the Lagoon 5A discharge stream data. The concentration discharged (nanocuries/liter) will be based on the total sewer flow since the lagoon and sewer streams are mixed prior to crossing the plant boundary.

This change to Lagoon 5A data should have the effect of providing data that are more representative of our actual discharge and eliminate the need to use a conservatively calculated value when reporting to the NRC. The sampling of the main sewer stream at the new waste effluent station will be continued as a verification that no anomolies have occurred in the plant or lagoon systems.

3.1.2 Gaseous

The amount of radioactive material discharged from building exhaust stacks over the past four years is summarized in Table I. Of the less than 15 microcuries discharged in 1985, 10.3 microcuries (69%) were from positive measurements from the two process off gas (POG) stacks, K-10 and K-32. All nine other stacks were routinely below the lower limit of detection. The less than 15 microcuries discharge during 1985 is approximately 7.5% of the licensed limit of 200 microcuries. This represents an increase from 1984 when only 3.5% of the limit was released and is not considered significant.

During 1985 the NRC requested that we use a lower limit of detection (LLD) for gaseous releases which is presented in Regulatory Guide 4.16. This is a more statistically valid method than the one used in the past. The use of the calculated LLD had the effect of increasing the reported minimum curies released from the nine stacks that are normally below the LLD. This increase had only a very small effect on our total release.

3.1.3 Groundwater

Discharge of radioactive material to the groundwater would occur if leaks developed in the liquid chemical waste storage lagoons. Leak detection consists of monitoring the sand layer between the two lagoon liners on a monthly basis, plus quarterly monitoring of the peripheral test wells around all six lagoons. Additionally, three of the lagoons have samplers in dry

wells beneath the lower liners, which are monitored monthly. The test well sampling and liner monitoring programs revealed no evidence of leakage to the groundwater.

3.2 External Exposure

The total man-rem external whole body exposure for the past three years for the organizations that have employees directly involved in fuel production activities are summarized in Table II.

The total man-rem dose decreased again this year by approximately 33%. The two groups having the highest average dose remained chemical and ceramic operations with their average dose being 200 mrem per year (50 mrem per quarter). The decrease in exposure in 1985 occurred across the entire operation. The maximum dose received by a fuel production worker was 520 mrem with 29 persons in the 250 to 500 mrem range.

Two hundred mrem is 5% of the company guideline which allows a maximum of one rem per quarter. The company guideline of one rem per quarter may be applicable to reactor workers but may be too high to be used as an investigation level for the uranium workers. This will be reviewed during 1986 by the ALARA Committee.

3.3 Estimated Internal Exposure from Airborne Radioactivity

The yearly average air contamination for several manufacturing areas is shown in Table III. All areas were below the company guide of 1x10-11 microcuries/ml.

The lung dose data comparison also listed in Table III is based on the maximum permissible air concentration (MPC) for insoluble uranium listed in 10 CFR 20. The MPC concentration (1x10-10 microcuries/ml) is that concentration which if breathed by standard man for 2000 hours per year for 50 years would result in

an equilibrium lung dose rate of 15 rem per year. With completion of the projects listed by Table VI the plant average annual air concentration continued to decline changing from 0.52x10-11 to 0.45x10-11 microcuries/ml. With the reduction in plant personnel during 1985 an even larger reduction was made in the estimated man-rem dose.

The reduction of the airborne contamination levels that has been obtained by improvements in the UO_2 Building facility, equipment (Table VI) and procedures is easily visualized by Figures I and II. From these figures, it may be concluded, that we have been able to control the average air contamination well within Company guidelines despite increasing production levels.

A similar conclusion cannot be drawn for the neutron absorber fuel (NAF) facility (Figure III) where air contamination increases as production levels increase.

All figures show the average quarterly air concentration to be well below the ENC guideline of 1x10-11 microcuries/ml. However investigation of the individual work stations has shown that there are several stations that, when operating, are normally above the company guide. The effect of "averaging" normally results in a much lower room average and, depending on the work schedule in the room, even one "high" week may be overwhelmed by three or more weeks of low throughput at the problem stations.

In addition to the Projects in 1986 to Reduce Airborne Levels (Table VII) a review has been performed to identify where upgrades are needed in facilities, equipment and procedures to obtain control over the air contamination sources, at individual work stations. The following are the work stations which had an average above the company guide for one quarter during 1985.

UO_2 Building

1) Blend Room Catwalk
2) Line 2 calciner drop hood
3) Line 2 utility hood
4) Line 2 northend of calciner
5) Line 2 northend of dryer
6) Lube blend room north and east hoods
7) Room 100 grinder #3
8) Room 100 bowl cleanout hood
9) Line 3 powder prep hood

NAF Facility, SF Building

1) Hammermill hood
2) Stacker (press) hood
3) Pellet inspection

3.4 Estimated Exposure Based on Lung Count Data

Lung count data for 1983, 1984 and 1985 is presented in Table IV. The highest lung count during 1985 that was not associated with external chest contamination was 0.27 nanocuries(5.06 rem). The average lung dose decreased slightly from 3.0 to 2.7 rem per person from 1984 to 1985 with a corresponding decrease in the total man-rem. This reduction appears to coincide with the reduction in airborne contamination. The data from 1985 are directly comparable to that of 1984 since the lung counting equipment used by BNWL was the same for both years. The inconsistency of the 1983 data obtained by the BNWL NAI detector system is easily seen by the comparison of the 1983 man-rem data to that of 1984 or 1985. Although our air sampling system is not setup to specifically estimate man-rem, there appears to be consistency between the man-rem data estimated from airborne contamination (Table III) and the man-rem estimated from the lung count data (Table IV).

3.5 Estimated Exposure Based on Urinalysis Data

Urinalysis data for three years are summarized in Table V. These data show that there was almost no change in the magnitude of the average positive samples in 1985 versus 1984. During July one employee had a urine sample of 26 micrograms per liter which is above our first action level (resample) of 25 micrograms per liter. A sample given four days later showed the employee's urine to be below the detection level (10 micrograms per liter). This was the only significant urine sample during the year.

The number of positive samples increased by approximately 73%. Most of the increase in positive samples occurred during the June 1 to November 14, 1985 period. The positive samples during this period were just barely above background. When this trend was reviewed in December 1985 U.S. Testing was requested to reevaluate 16 samples that they had reported as being positive. This reanalysis resulted in U.S. Testing concluding that 10 of the samples reported as positive (above 10 micrograms uranium per liter) should have been reported as below the lower limit of detection. U.S. Testing subsequently took action to correct their method of analysis and in December 1985 and January 1986 the number of positive samples has returned to "normal".

Using the data obtained by the U.S. Testing reevaluation, the number of positive specimens in 1985 is estimated to be approximately equal to the number positive in 1984. Thus the man-rem for 1985 may be estimated to be very close to the man-rem of 1984.

3.6 Unusual Occurrences and Audits

3.6.1 Unusual Occurrences

There were no unusual occurrences related to direct radiation exposure or effluents. There was one investigation by Radiological Safety of an individual who may have performed an inadequate survey and had potential for transporting beta contamination to his home. The home survey found no beta contamination but some very slight (releaseable) alpha contamination on the sole of one shoe.

Low level uranium personnel contamination is not considered an unusual occurrence. However, during 1985 six employees were found to have low level uranium skin contamination when lung counted. All six employees were recounted later and again two were found to have low level skin contamination.

To be indicated as being contaminated by BNWL's IG lung counter, the contamination must be on the chest and must have survived the precount shower which is mandatory. These contamination levels are too low to be picked up by a normal personal survey and do not represent a hazard to personnel.

3.6.2 Audits

During 1985 the NRC conducted four inspections. None of these inspections resulted in a health physics related finding. Corporate Licensing performed 12 monthly audits, reporting 13 findings and 16 observations. Most findings were closed out (resolved in a timely manner). The only problems not completely resolved relates to the contamination resulting from drum tumbling and drum pallet contamination. Engineering continues to work on these two problems.

4.0 RECOMMENDATIONS

4.1 Status of Previous Recommendations

The 1982 ALARA Report recommended that ENC utilize the computer system as a method of following personnel urinalysis, in-vivo, direct exposure and training data in order to minimize oversights. The implementation of this recommendation was delayed. The data for physical examinations have been placed on the computer. Safety and Security has established a goal to have the computer program for the remaining data in place by the end of 1986, with the input of data to begin in 1987.

The 1984 ALARA Report identified three recommendations:

1) That the potential for separating uranium daughters be reviewed by engineering for all plant processes and that a sampling program be established to verify the presence or absence of uranium daughters in ENC's effluents.

   Certain waste streams have been identified as having a significant daughter content and are retained for decay prior to discard. The LUR process will be reviewed following start up this spring.

   Several samples of liquid effluent have been analyzed by U.S. Testing however the data is not conclusive and additional sampling is required.

2) That U.S. Testing procedures, practices and in-house quality control program be audited and that blind samples be submitted to test the accuracy of the urinalysis and TLD programs.

   During 1985 U.S. Testing procedures, practices and in-house quality control program were not formally audited. ENC's effort to provide uniform exposure to a group of dosimeters does not appear to have been

successful. U.S. Testing will be formally audited and additional dosimeters will be exposed and submitted during 1986. Test urinalysis specimens were not submitted during 1985. This program was initiated in 1986.

3) That the ALARA Committee review the appropriateness of the current company guide for airborne uranium contamination of 1x10-11 microcurie/ml. This review was completed during the ALARA committee meetings of April of 1985. It was concluded by the committee that the current guide is applicable and appropriate. An increase in the guide did not appear appropriate in light of the NRC proposed air concentration limit reduction to $2x10^{-11}$ microcuries/ml. Reducing the limit did not appear warranted based upon lung count data. It did appear appropriate to continue efforts towards air concentration reduction at those few individual work stations which do not consistently meet the current guide. This item was closed.

4.2 New Recommendations

It is recommended that a review be performed to identify possible upgrades in facilities, equipment and procedures to obtain better control over the air contamination sources at specific work stations that have a quarterly average over the company guide. Work stations that should be subject to this kind of review are listed in Section 3.3.

TABLE I

SUMMARY OF RADIOACTIVE MATERIAL IN EFFLUENTS[1]

	Gaseous Effluent to the Atmosphere (μCi)			Liquid Effluent to City Sewer System (Ci)	Release to Groundwater (μCi/ℓ)
Year	U	Pu	FP[2]	Uranium	Uranium[3]
1982	<22	<0.1		<0.080	<MDC
1983	<24	<0.1		<0.093	<MDC
1984	< 7[4]	<0.1		<0.068[5]	<MDC
1985	<15	<0.02[6]	<2.88	<0.080	<MDC

1 Where the constituent was present at levels below the minimum detectable capabilities of the measuring equipment. The value is included in the data at the detection limit.

2 Accurate sampling of fission product releases from the Irradiated Tool and Equipment (ITE) Building stack was begun in 1985.

3 The minimum detectable concentration (MDC) is listed for groundwater, since the test well samples consistently show less than the minimum detectable concentration of 2×10^{-4} microcuries/liter.

4 There was a reduction in total exhaust when some of the building exhaust systems were shutdown for maintenance during the July-August 1984 furlough.

5 Thorium was identified as an effluent of the ELO Gadolinia Separations operation, approximately 0.47 curies of Thorium-234 and Protactinium-234 were discharged in addition to the uranium.

6 Reported only for the first half of the year.

TABLE II

EXTERNAL WHOLE BODY EXPOSURE

Organization	No. of Employees			Avg. Exposure (Rem)			Total Man-Rem		
	83	84	85	83	84[1]	85	83	84	85
Chemical Op.	34	40	34	0.27	0.25	0.20	9.2	10.0	7.0
Ceramic Op.	30	32	30	0.31	0.27	0.20	9.3	8.6	6.0
Rod Fab. & Ass.	41	36	40	0.16	0.12	0.10	6.6	4.3	4.0
Maintenance	81	80	68	0.09	0.05	0.03	7.3	4.0	2.0
NAF[2]	11	9	0	0.15	0.19	0.00	1.7	1.7	0.0
All Others[3]	82	99	103	0.11	0.07	0.04	9.0	6.9	4.1
Total	279	296	275	0.15	0.12	0.08	43.1	35.5	23.1
Fuel Performance (Reactor Exposure)	12	17[4]	15[4]	0.75	0.69	0.58	9.0	11.8	7.8

Man-Rem[5]
1983 - 43.1
1984 - 35.5
1985 - 23.1

1 Based on ten months of exposure.
2 Neutron Absorber Fuel Facility (NAF) group was combined into the chemical and ceramic operations during 1985.
3 Other production related personnel such as QC, lab personnel and some engineering groups.
4 Includes exposure to four people loaned to this group in 1984 and three people in 1985.
5 Does not include the "Fuel Performance" personnel.

TABLE III

AIRBORNE URANIUM CONCENTRATION DATA

Area	Average Concentration (10^{-11} µCi/ml)			Calc. Average Lung[1] Dose (Rems/Person)		
	83	84[2]	85	83	84[2]	85
Line I	0.68	0.51	0.48	1.02	0.77	0.72
Line II	1.40	0.64	0.55	2.10	0.96	0.83
Press	0.72	0.72	0.65	1.08	1.08	0.97
Grinder	1.20	1.09	0.71	1.80	1.64	1.07
U_3O_8	0.19	0.15	0.23	0.29	0.23	0.35
Lube Blend	0.86	0.63	0.73	1.29	0.95	1.10
Uranyl Nitrate	0.49	0.21	0.21	0.74	0.32	0.31
Scrap Recovery	0.43	0.14	0.21	0.65	0.21	0.31
Powder Storage	0.48	0.48	0.28	0.72	0.72	0.42
NAF	0.91	0.59	0.48	1.37	0.89	0.72
Plant Avg.	0.74	0.52	0.45	1.11	0.78	0.68

	(Estimated) Man-Rem
1983	150
1984	108
1985	84

1 Based on ICRP II, $1x10^{-10}$ microcuries/ml of insoluble material as continuous intake for 2000 hours for 50 year results in a lung dose limit of 15 rem per year.

2 Ten-month average.

TABLE IV

LUNG COUNT DATA[1]

Organization	No. of Employees Examined			Number Employees Positive			Avg. of Positive Meas. (μCi U-235)			Avg. Lung Dose[2] of Positive Mea. (Rem/Person)		
	83	84	85	83	84	85	83	84	85	83	84	85
Chemical Op.	35	41	35	4	16	12	0.133	0.167	0.154	2.5	3.1	2.9
Ceramic Op.	31	28	25	6	12	9	0.137	0.183	0.148	2.6	3.4	2.8
Rod Fab & Ass.	3	5	6	0	0	1	0.000	0.000	0.160	0.0	0.0	3.0
Maintenance	57	65	58	0	2	5	0.000	0.125	0.124	0.0	2.3	2.3
NAF[3]	9	9	0	1	3	0	0.128	0.115	0.000	2.4	2.2	0.0
Subtotal/Avg.	135	139	124	11	33	27	0.135	0.166	0.147	2.5	3.1	2.8
All Others[4]	74	69	118	0	2	9	0.000	0.12	0.132	0.0	2.3	2.5
Total/Avg.	209	208	242	11	35	36	0.135	0.163	0.143	2.5	3.0	2.7

Man-Rem	
1983	27.5
1984	105
1985	97.2

1 1983 data from BNWL using NaI detector system.
1984 data from BNWL - 75% from IG system, 25% from NaI system.
1985 data from BNWL IG system.

2 0.8 nCi U-235 with a 500-day effective half-life provides 15 rem during the 365 days following the measurement.

3 Neutron Absorber Fuel (NAF) Facility group was combined into the chemical and ceramic operations during 1985.

4 Other production related personnel such as QC, lab personnel and some engineering groups.

TABLE V

URINALYSIS DATA

Organization	No. of Employees Examined			Number of Samples			Number Samples Positive			Avg. of Positive Samples µgm U/L			Avg. Dose[1] of Positive Mea. (Rem/Person)		
	83	84	85	83	84	85	83	84	85[2]	83	84	85	83	84	85
Chemical Op.	34	41	35	497	507	445	45	33	22	18.1	16.0	14.3	0.14	0.13	0.12
Ceramic Op.	30	32	28	350	287	289	22	5	20	16.4	12.5	12.9	0.13	0.10	0.10
Rod Fab & Ass.	6	6	6	6	69	55	0	0	0	0.0	0.0	0.0	0.00	0.00	0.00
Maintenance	81	74	59	585	749	612	19	15	29	22.4	13.7	14.0	0.18	0.11	0.11
NAF[3]	11	9	0	107	87	0	2	0	0	13.1	0.0	0.0	0.10	0.00	0.00
All Others[4]	117	83	102	316	256	414	4	2	24	12.8	11.1	12.7	0.11	0.09	0.10
Total	279	255	230	1861	1955	1815	92	55	95	18.2	14.9	13.5	0.15	0.12	0.11

Man-Rem
1983 - 13.8
1984 - 6.6
1985 - 10.45

1 Assumes an instantaneous uptake of 50% Class D and 50% Class W material and a two week lapse between inhalation and urine specimen (0.0082 rem/microgram U/liter). Dose limit is 15 rem at 3 wt% U-235 the radiation exposure hazard is approximately equivalent to the chemical hazard of uranium.

2 See paragraph 3.5.

3 The Neutron Absorber Fuel (NAF) Facility group was combined into the chemical and ceramic operations during 1985.

4 Other production related personnel such as QC, lab personnel and some engineering groups.

TABLE VI

PROJECTS IN 1985 TO REDUCE AIRBORNE LEVELS

CHEMICAL AREA

A. Completed Projects

1. A vacuum transfer line was installed between the line 1 recycle hood and blender eliminating the need to make and break temporary lines.

2. Extensions were installed on several Vac-U-Max filter hoods to provide containment during filter change-out.

3. U_3O_8 equipment was modified to improve containment and reduce contamination spread. Hood extensions were provided as were furnace door bridges and spill plates. The U_3O_8 receiving hood was modified.

4. A recycle hood was added to the scrap calciner to reduce airborne in the scrap recovery area.

5. Exhaust air was provided at the line 2 calciner bellows so that airborne will be reduced if the calciner offgas line is plugged and the bellows opens to reduce calciner pressure.

6. Exhaust ventilation was provided in the areas where the ADU dryers are cleaned.

B. Cancelled Projects

1. The drum feed to powder prep project was reevaluated and dropped on the basis of not offering sufficient improvement to process control to justify it. Only one action has been currently planned to otherwise reduce airborne contamination associated with the vacuum transfer systems. This action consists of providing an automated powder drum unloader, currently identified as a 1987 project.

CERAMIC AREA

A. Completed Projects

1. An additional hood was provided for transferring scrap pellets into five gallon cans.

2. A new hood was installed on press #1 which improved containment and significantly reduced airborne in that area.

3. An improved grinder bowl cleanout hood was installed.

4. Exhaust air inlets in the grinder area were moved from the east wall to locations directly adjacent to each of the grinder lines for more effective control of airborne contamination.

5. The grinder water system was upgraded to reduce smearable contamination potential.

6. New boat dumping systems and hoods were installed in grinder lines #2 and #3 reducing airborne in that vicinity.

TABLE VII

PROJECTS IN 1986 TO REDUCE AIRBORNE LEVELS

CHEMICAL AREA

A. New Projects

1. Scoping and AR's will be prepared for the following projects: installation is expected to be accomplished in 1987.

- Upgrade of line 2 POG scrubber system to reduce HEPA filter changeout frequency.
- Improved containment of all powder prep lines.
- Installation of a hooded station in line 2 for handling waste and miscellaneous materials.
- Installation of an automated drum unloader to eliminate wand usage for recycle.
- Upgrade of line 1 HVAC and POG systems for better air distribution and contamination control.
- Modification of the NAF grinder line with a new boat dumper and hood and new bowl feeder and dryer having improved exhaust air ducting.

B. Projects in Progress

1. Platforms are being installed at the line 1 recycle hood and the UNH Vac-U-Max filter stations to provide better access for operation and maintenance, thus lowering the risk of contamination spread. ECN's 1502 and 1506 are routing to cover these additions.

2. Lube blend room rearrangement with addition of drum conveying system is under study aimed at eliminating the movement of pallets into the Ceramics area and thus reducing contamination spread. The rearrangement is now planned for 1986 - the conveying system addition which is a capital project, is deferred to 1987.

CERAMICS AREA

A. New Projects

1. Containment improvements will be made to the grinder centrifuge bowl cleaning station.

Smaller Upgrade and Maintenance Projects

There will be a continuing effort to detect and eliminate sources of airborne such as leaking gaskets, improperly sealed doors, ineffective hoods, and aging equipment.

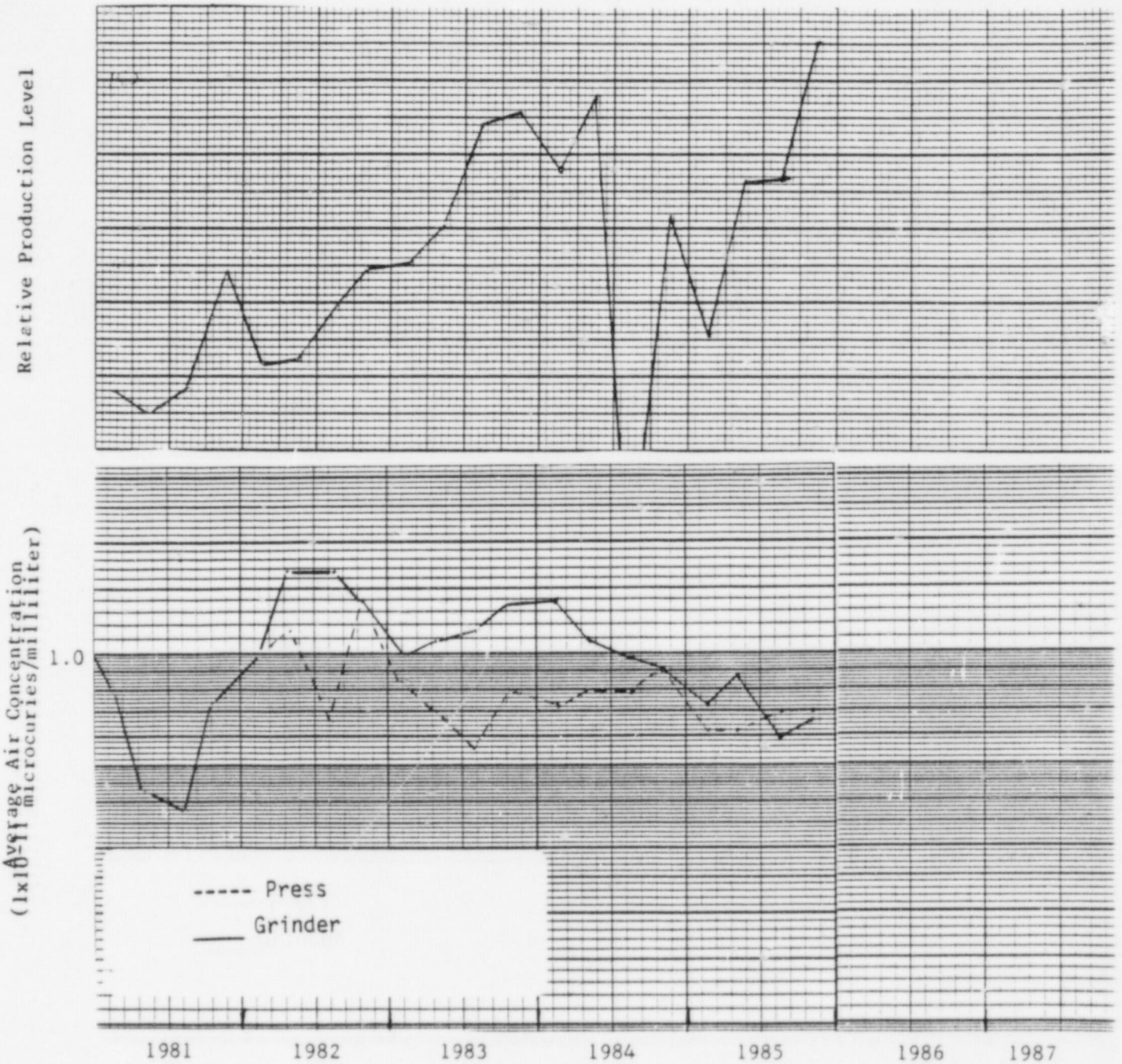

Figure I

Ceramics
Production and Air Concentration

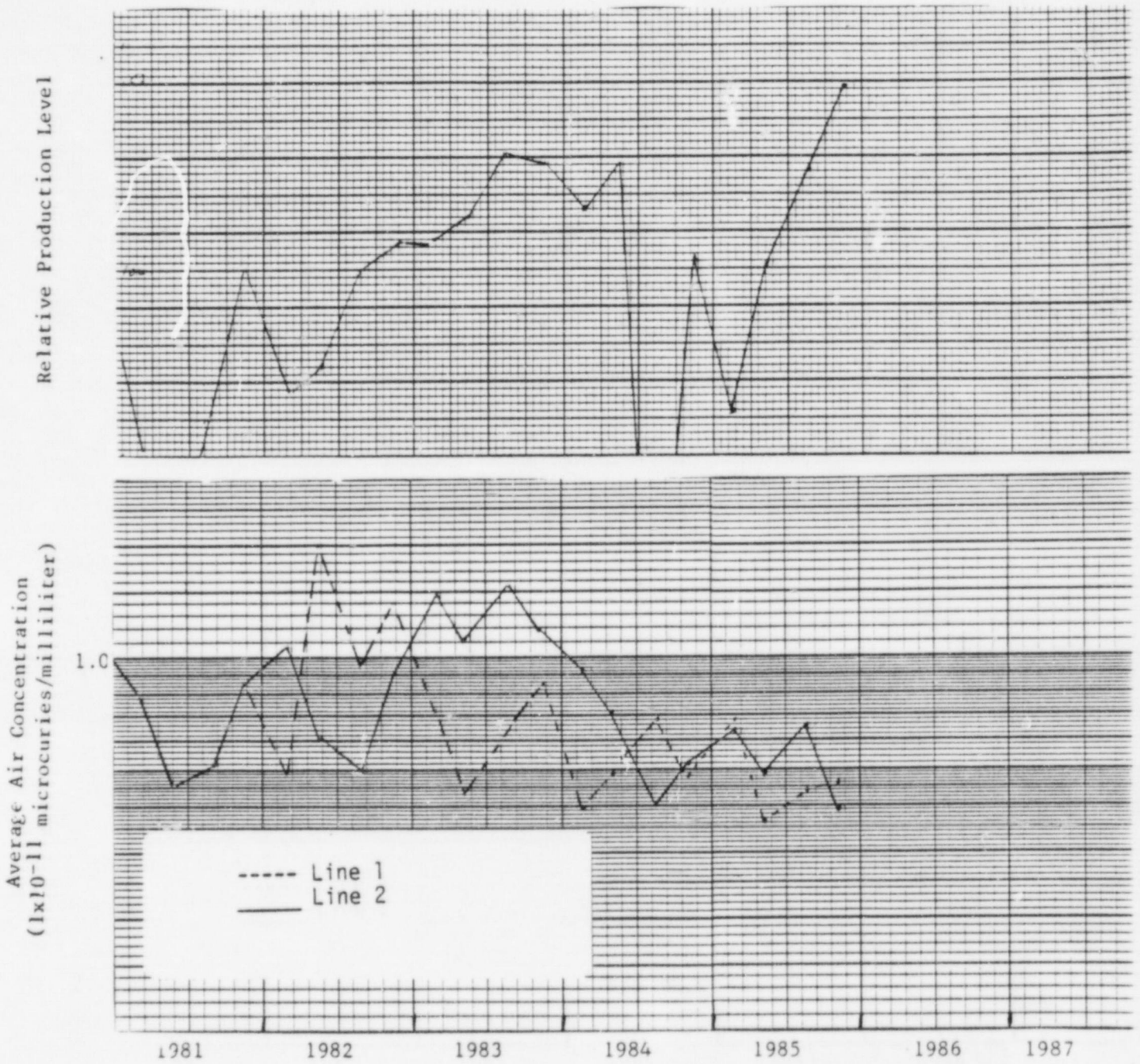

Figure II

Chemical
Production and Air Concentration

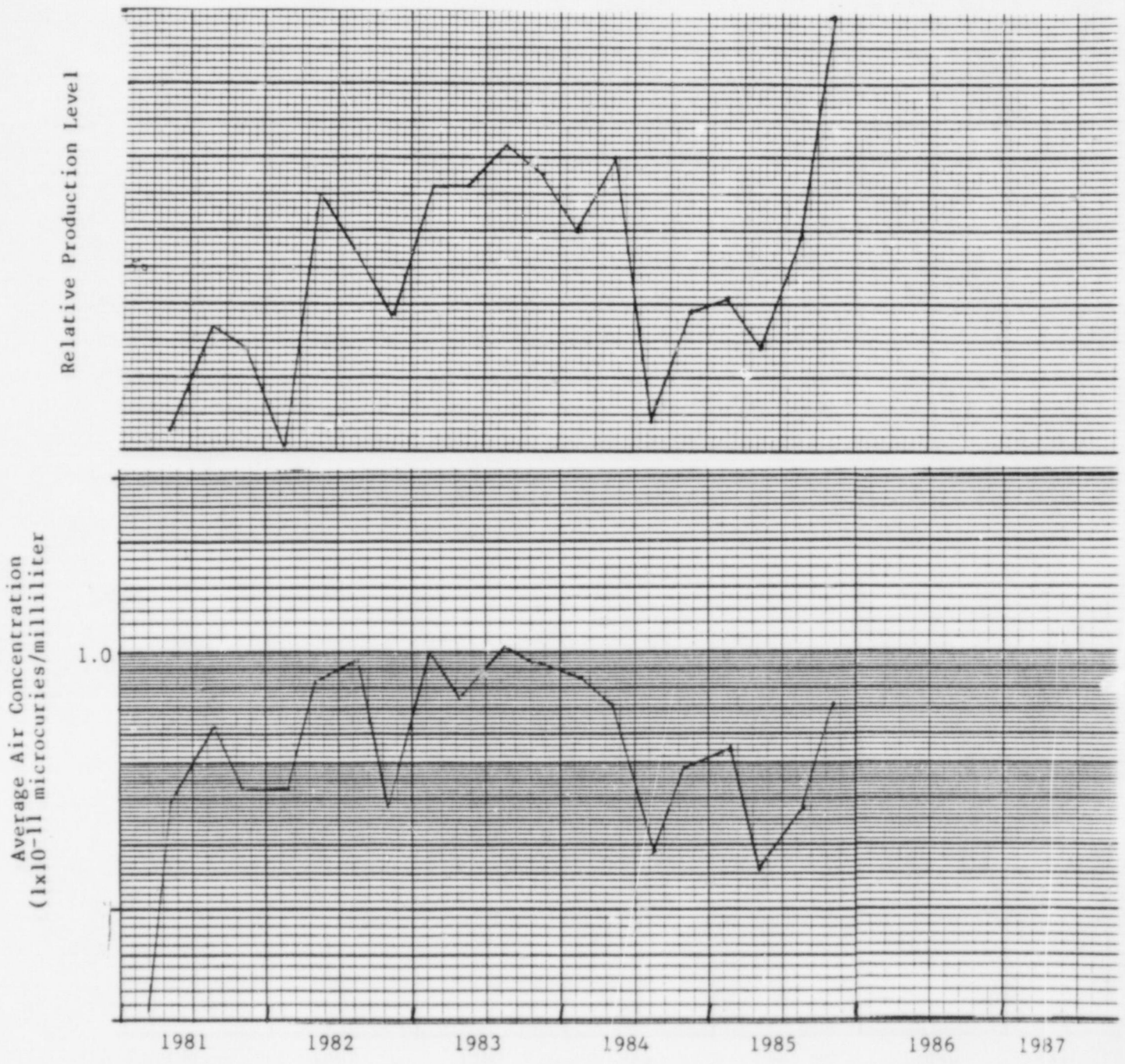

Figure III

NAF
Production and Air Concentration

CHAPTER 13

ENVIRONMENTAL SAFETY - RADIOLOGICAL AND NONRADIOLOGICAL

CHAPTER 13 ENVIRONMENTAL SAFETY - RADIOLOGICAL AND NONRADIOLOGICAL

The Exxon Nuclear environmental surveillance program consists of periodic collection and analysis of samples from the plant gaseous and liquid effluent streams (including the leak detection system for the liquid chemical waste storage lagoons) and selected elements of the local environs. Information on environmental monitoring and releases is provided by the supplement to the applicants Environmental Report XN-NF-14.

13.1 External Radiation

The background radiation level in this part of Washington State is approximately 60 mrem/yr. There are no plant radiation sources which increase external exposure at the plant boundary above background.

13.2 Gaseous Effluents

Continuous isokinetic sampling is provided for each exhaust stack with the samples collected and measured at least weekly. The samplers are located downstream of the final HEPA filters. The total uranium discharged out of all stacks has averaged less than 25 microcuries per year during the last five years. This amount of uranium (less than 16 grams/year) has had essentially no impact on the cumulative off-site exposure due to uranium fuel cycle operations. Soil samples off-site have shown no increasing trend in uranium concentration and have remained well below acceptable levels. Using a worst case CHI/Q value of 0.114-4 with ICRP 30 methodology a committed dose equivalent on the order of 21 micro rem may be estimated from gaseous discharges.

13.3 Liquid Effluents

All liquid effluents are joined together on plant, continuously sampled and pumped into the City of Richland sewer system. Three types of liquid waste are blended into a single sewer flow, these are the sanitary wastes, the noncontact cooling water, and the liquid chemical waste. Liquid chemical wastes were first discarded in the last quarter of 1984.

Uranium releases to the sewer have remained below 1/10 of the CFR quantity limit and less than 1/100 of the CFR concentration limit. A review of the chemical discharges shows an increase in suspended solids, NO3 and fluoride associated with the start of the chemical discard, however all chemical discards have remained within the limits of the State of Washington Waste Discard Permit as issued by the Department of Ecology.

13.4 Groundwater

There has been no leakage to the groundwater as evidenced by the groundwater sampling program. There have been two leaks through the first liner in lagoon 2. Inspection of the lower liner following the second leak confirmed it to be sound which supports the fact that there were no increases in groundwater activity.

13.5 Field Sampling

Off-site sampling for fluoride in the vegetation and the ambient air has shown the concentrations to be well within the State limits of 40 ppm and 0.5 ppb respectively. Off-site sampling for uranium in the soil has shown no increasing trend in the concentration during this latest five year license period.

CHAPTER 14

NUCLEAR CRITICALITY SAFETY

CHAPTER 14 NUCLEAR CRITICALITY SAFETY

14.1 Administrative Practices

Administration and technical practices for ensuring criticality safety are detailed in documents XN-NF-30 (Safety Manual) and in XN-NF-31 (Nuclear Criticality Physics Manual), respectively. These documents are implemented in accordance with the Responsibility Matrix in Chapter 2.

The practices used to ensure criticality safety include:

1. Establish a validated methodology for performing Criticality Safety Analyses (CSAs). Details are provided in Section 14.6.

2. Establish the procedures to ensure that all equipment/operations are reviewed and approved for criticality safety before introduction of SNM. See Section 11.6 for details.

3. Perform CSAs for the equipment/operations to be authorized for SNM processing. The CSA will include an assessment of the worst credible accident condition. All modifications to existing equipment/operations with SNM will be analyzed for criticality safety impact before their implementation. Details on basic assumptions in CSAs are given in Section 14.3. The completed CSA is subjected to an independent second-party review to assure that the methods, accident conditions, models, cross sections, etc., are adequately conservative.

4. Establish the specifications and procedures required to ensure that the limits assumed in the CSA are conservatively met at credible accident conditions.

5. Before introducing SNM, inspect equipment and procedures to ensure that the assumptions employed in the CSA are conservative.

6. Ensure that the limits and procedures are known and understood by the people dealing with SNM using postings, specifications, operating procedures, and training. Details are in Sections 2.5, 2.6, 4.1.5 and 4.1.6.

7. Audit the equipment and procedures to ensure continued compliance with the limits established in the CSA, and to ensure that all credible accident conditions have been adequately addressed. Details are in Section 2.7.2.

14.2 Equipment Design Criteria

The preferred equipment design will be safe geometry; i.e., the design will be safe at the worst credible combination of geometry, enrichment, moderation, reflection, and interactions with other systems.

If the design is not of safe geometry, then appropriate administrative controls will be used to ensure that no single credible violation of the limits to be specified will result in a criticality.

Details of CSA methods and administrative controls are in Section 14.3.

14.3 Basic Assumptions

14.3.1 Accident Conditions

Credible accident conditions are postulated for the proposed design in its environment. The postulated accident conditions typically include:

1. Changes in the dimensions and/or spacings of the system units.
2. Changes in density and/or moderation of the contained SNM.
3. Deviations from mass or concentration limits, if applicable.
4. Changes in dimensions, mass, concentration, or form of neutron absorbers, if applicable.
5. Interactions with fixed and in-transit units at their most reactive credible state. For example, in-transit containers are typically assumed to be accidentally placed into the most reactive location in the system; usually in contact with one or more of the most reactive units in the system.
6. The effect of cascading errors from and to upstream and downstream operations.
7. Changes in interspersed moderation and in location and composition of reflectors.
8. Accidental introduction or accumulation of SNM into vessels or other locations that have not been adequately reviewed for criticality safety. The effects of SNM leaks and spills are considered.
9. Effects of mechanical failure and loss of power, air pressure, etc., as appropriate.

10. Effects of vessel overflows, siphoning, oil leaks, water leaks, water sprays, vent obstruction, pressurization, instrument malfunction, etc., as appropriate.

11. Potential for enhanced reactivity due to heterogeneities in nominally homogeneous systems.

12. Potential for enhanced reactivity due to diameter, pitch, and interspersed moderation effects in systems composed of normally close-packed rods or other arrays without constraints on pitch.

13. Effects of fire, fire-fighting, flooding, and credible extremes of temperature and humidity.

14. Other potential human errors or unauthorized procedures.

If accident conditions are not independent and of low probability, then combinations of conditions are assumed. If combinations of accident conditions may lead to unacceptable k_{eff}'s, then design changes and/or administrative controls are specified to minimize the probability and consequence of accidental deviation from the limits. If any single credible accident can lead to an unacceptable k_{eff}, design modifications or administrative controls are implemented as required to convert this single accident into two or more independent accidents of low probability.

14.3.2 K_{eff} Calculation

Most k_{eff} calculations for non-elementary geometries or SNM compositions are performed using cross sections and computer codes from the SCALE[1] system. These cross sections and codes have been extensively benchmarked against data from critical experiments. This benchmarking has been performed by Exxon Nuclear and others around the world.

K_{eff} values for elementary systems and compositions may be estimated using buckling calculations with data from sources such as DP-1014[2] and ARH-600[3].

Single unit safety for elementary geometries may be demonstrated using established critical dimension limits and appropriate safety factors as described in Section 4.2.3.

Neutron interaction in multi-unit arrays may be assessed in accordance with the Solid Angle Method (Section 4.2.7.5).

Previously approved codes/cross sections (GAMTEC, DTF, HFN, HAMMER, CCELL for example) have been used for analyses and may be used in the future.

14.3.2.1 Cross Sections

Calculations are routinely performed using the Knight-modified Hansen-Roach cross section library. Replicates using NITAWL-processed cross sections from the 27 group library (subset of 218 group CSRL based on ENDF/B-IV) or from the 123 GAM-THERMOS library may be performed for comparison. BONAMI-processed 16 group cross sections have also been used.

The resonance self-shielding effects are conservatively modeled:

1. Codes such as BONAMI are used to estimate the Dancoff factor and the effective moderation cross section for resonance nuclides. A Monte Carlo code is also used to calculate Dancoff factors for heterogeneous systems where an infinite lattice is not assumed as in BONAMI. Thus, more accurate average values for finite lattices and if desired, for individual rod types such as edge, corner, and interior may be employed. Since the effect of these refinements is typically small, and since the results using infinite-lattice parameters are often more conservative, this is considered optional.

2. The appropriate U-235/U-238 nuclides may be selected from the Knight-modified Hansen-Roach library; or

3. The BONAMI self-shielded cross sections may be used; or

4. NITAWL is used for self-shielding calculations, typically using the Nordheim option.

14.3.2.2 Computer Codes

Most or all calculations are performed using XSDRNPM or KENO-IV. Other codes such as KENO-V and MORSE may be employed in the future after appropriate validation but KENO-IV is the most versatile with its generalized geometry option.

All improvements/corrections to the codes are maintained as distributed by the Radiation Shielding Information Center (RSIC).

XSDRNPM is used for models appropriate for a 1-D transport theory code. It is also used for cell-weighting of heterogeneous systems and for cross section collapsing.

KENO-IV, a 3-D Monte Carlo code, is the most frequently used code for estimating system k_{eff}'s.

The key parameters in these calculations are:

1. Verify that the appropriate resonance self-shielding corrections have been applied to the cross sections used.

2. Verify that the nuclides and the atom densities in the mixing table conservatively represent the media in the system.

3. Verify the accuracy of the geometry model. Ensure that dimensions and media are appropriate for the condition being tested. To help verify the geometry model, computer plots of the KENO geometry model are routinely made. These plots are used to ensure that the overall model and the units in the model are appropriate.

4. Verify that the solution is well converged. If significant trends in generation k_{eff}'s are present or if the generation k_{eff} distribution is abnormal, determine if additional generations or a different start type is needed.

5. Examine the data on flux, fission density, and by-group absorption-leakage-fission for anomalies. Assure that the most reactive region was adequately sampled and if necessary, replicate the case with all or most first generation neutrons starting in the most reactive region.

14.3.3 SNM Properties

14.3.3.1 Homogeneous Systems

The most frequently encountered homogeneous fissile materials are:

1. UO_2 powder with various moisture contents.

2. U_3O_8 powder with various moisture contents.

3. UF_6 (solid, liquid, or gas) in shipping cylinders or in piping.

4. UO_2F_2-HF-water solutions resulting from UF_6 hydrolysis.

5. Ammonium Diuranate (ADU) as dry powder, aqueous slurry and "pastes" with water contents between these extremes.

6. Uranyl nitrate in aqueous or organic solution.

7. Random arrangements of short fuel pellets are often modeled as a homogeneous mixture.

8. Uncertain compositions or mixtures are typically modeled as UO_2-water if deemed to be conservative.

Homogeneous mixtures are routinely modeled as UO_2-water. This is adequate to cover the range of credible reactivities of UO_2, U_3O_8, and UO_2F_2. Since the nitrogen in mixtures such as uranyl nitrate and ADU absorbs neutrons more than equal amounts of oxygen or fluorine, the nitrogen content is typically set to zero or to a minimum credible value with no credit for the excess nitrate and/or ammonium that may be in the actual system.

A given two-phase mixture such as UO_2-water is modeled as a single homogeneous phase as follows:

1. The uranium density in the mixture is specified. For optimally moderated UO_2-water, the typical value is about 2.0 gm U/cc. Examples of calculations based on this uranium density are given below.

2. Assuming that the solid phase particles are at their theoretical density, determine the volume fraction occupied by the solid phase. For UO_2, the theoretical density is 10.96 gm UO_2/cc, which is about 9.66 gm U/cc. Therefore, the volume fraction UO_2 is about 0.207.

3. The remaining volume fraction is assumed to be filled with water. Therefore, the mixture contains no air or voids and is saturated with water. The volume fraction water in this case is 0.793.

4. For this example, the mixture will contain about 2.269 gm/cc UO_2, and about 0.793 gm/cc water for a total bulk density of about 3.062 gm/cc. Therefore, this mixture is about 25.9 wt% water.

5. Assuming 5% enriched uranium, the U-235/U-238 densities are 0.1 and 1.9 gm/cc, respectively. The atom densities for the UO_2 constituents (U-235, U-238, O) in atoms/(barn-cm) are 2.5625E-4, 4.8073E-3, and 1.0127E-2, respectively. The atom densities for the water phase would be 0.793 for a macroscopic mixture such as Hansen-Roach nuclide #502, or the microscopic H and O nuclides may be used with atom densities of 5.2918E-2 and 2.6459E-2, respectively.

6. The "sig-p" values for U-235 and U-238 are about 5080 and 271 barns, respectively. If a finite system is being modeled, the microscopic sig-escape may be calculated and added to the sig-p

values to yield the sig-m (eff) (effective moderation cross section). If more than one fissile unit is present, appropriate corrections involving the Dancoff factor are made.

7. Based on the sig-m (eff) values, the appropriate U-235/U-238 nuclides are selected from the Hansen-Roach library or BONAMI may be used with the atom density and geometry inputs or NITAWL may be used for 27/123 group libraries. Assuming that the Hansen-Roach cross sections are used, the nuclides selected have a designated sig-p less than or equal to that of the system. Weighted averages of nuclides are typically used as shown below in a KENO-type mixing table for the 2.0 gm U/cc example.

	-92510	1.1783E-4
	92511	1.3843E-4
	92829	2.2081E-3
	92830	2.5992E-3
	8100	1.0127E-2
	502	0.793

Other UO_2-water mixtures with other uranium densities may be similarly formulated and used in XSDRNPM/KENO to calculate k_{eff}. The mixture with the highest k_{eff} is taken as the optimum moderation condition.

Fortunately, data are available (e.g., Section III.B of ARH-600) to allow rapid estimation of the optimum conditions. Figure III.B.10(5)-1 and III.B.10(5)-2 contain k-inf, material buckling, migration area, and extrapolation distance data for a wide range of uranium densities in the UO_2-water and uranyl nitrate-water systems. Based on these data and confirmed by several actual cases analyzed, the optimum moderation condition assumed for preliminary estimates is typically 1.9-2.1 gm U/cc. The actual optimum may differ slightly depending on the geometry and reflection conditions.

It is noted that the uranium concentration to yield the minimum critical mass is different from that for peak reactivity.

For two-phase mixtures not saturated with water or for single phase mixtures, the atom density calculations depend on assumed (modeled) values for H/U (or wt% water or wt% other diluent) and on bulk density data for the mixture. All other nuclide selection procedures are as described for saturated two-phase mixtures.

For systems without mass limits, the units are assumed to be full of the most reactive credible mixture.

For systems with specified mass limits such as 5-gallon cans of UO_2 powder, the most reactive uranium density for a single or double-batched container is assumed. Typically, the most reactive geometry-mixture combination is to fill the container with a saturated UO_2-water mixture of about 0.82 gm U/cc (single batch) or about 1.64 gm U/cc (double batch). If higher uranium densities were used, the fissile geometry would be less reactive for the modeled contained mass.

14.3.3.2 Heterogeneous Systems

Typical heterogeneous systems are:

1. Unclad UO_2 pellets on trays which are routinely stacked.

2. Normally close-packed fuel rods on geometry control or with controls on number of rods together.

3. Fuel assemblies.

Most operations with heterogeneous systems are not normally moderated. Although arrays of vessels containing homogeneous mixtures may be considered as heterogeneous in the overall array, these are treated as interaction or multi-unit cases. The only two normally moderated heterogeneous systems currently used are rod etching and rod autoclaving. All systems are analyzed assuming that the rods are at the diameter-pitch-moderation combination to yield peak k_{eff}. For flooded systems, the most reactive diameter-pitch combination (assuming unclad 5% enriched pellets) is a 0.30-0.40 inch diameter with a water/fuel volume ratio of 2.5-3.5. The parameters typically assumed for preliminary calculations are 0.350 inch pellet diameter with a Vw/Vf of 3.0 (pitch = 0.6204 inch). The reactivity is relatively insensitive to minor variations of diameter/pitch at this condition. The data of DP-1014 may be consulted to verify these parameters.

For moderator densities less than 100% (full density water), the optimum moderation condition is strongly dependent on the system geometry. The peak reactivity typically increases with increasing pellet diameter, at least for those diameters typically encountered in LWR fuel designs. Accordingly, the maximum credible pellet diameter is typically assumed for optimum (low density water) moderation condition searches.

All systems must have an acceptable k_{eff} when fully flooded and fully reflected. Certain cases, typically rod storage cabinets with tiers of "slabs" of rods, may exceed the k_{eff} limits if optimum moderation and close-fitted reflection are assumed. The range of moderation levels with unacceptable k_{eff}'s is typically small and the optimum water density is typically low, 1-10 vol% water, for example.

While these conditions are deemed not credible, additional controls are implemented to make the probability even more remote.

1. The array will be fully enclosed and water must be capable of freely draining from the system.

2. The array is designated as a moderation-controlled area. The low probability of unacceptable moderation at conditions such as fire fighting is verified.

3. Strict controls on storage of hydrogenous materials such as paper and plastics are imposed.

Even if low density interspersed moderation was accidentally introduced into these cabinets, they would typically remain subcritical because:

1. The rods within the slabs would be grossly undermoderated compared to the optimum-pitch rods modeled.

2. Typical cabinets are free-standing with significant reflection only by the floor. Therefore, neutron leakage would be much greater than the fully reflected case. Attaining a fully reflected exterior with low density moderator inside would be difficult. The spacing between tiers of slabs would greatly reduce the k_{eff} if filled with full density water.

3. The cabinets typically contain steel walls, support members, and trays which are conservatively not modeled (typical) but, in fact, neutron absorptions in this steel would tend to lower the peak k_{eff} to acceptable values for all moderation levels.

14.3.4 Administrative Control Models

14.3.4.1 Mass Controls

Mass-controlled systems such as 5-gallon powder containers are controlled to not more than one "safe" batch, defined as 45% of the minimum critical mass for a fully reflected spherical geometry. Obviously, bringing two safe batches together in one or two containers will be a safe condition. Additional controls imposed to assure safety at credible accident conditions are:

1. Certified dry (typically 1.5 wt% maximum equivalent moisture content) containers may be stored edge-edge in designated arrays in moderation-controlled areas.

2. Moderated materials (including all materials not certified dry) are typically stored in single tier planar arrays with at least 12 inches edge-edge spacings.

3. Only designated containers may be used.

These arrays are typically demonstrated safe with at least two simultaneous accident conditions such as double batching, double stacking, edge-edge contact, and loss of moderation control.

As stated earlier, these systems are modeled as full of relatively low density UO_2-water, the most reactive geometry-moderation combination. Close-fitted full water reflection is assumed at the model boundaries.

14.3.4.2 Moderation Controls

Systems with moderation controls are subjected to a sensitivity analysis. The systems are modeled at the maximum credible uranium density (typically 3.5 gm U/cc = 3.97 gm UO_2/cc). The H/U (typically, wt% water) of the SNM is the key variable for sensitivity analysis. The specified moderation limit is not greater than half of the moderation required to produce a k_{eff} of 0.95 assuming the worst credible combination of reflection and interaction.

For geometries unsafe at optimum moderation, the SNM to be entered is held and sampled in a safe geometry vessel until it has been certified dry and released by supervision. Once certified, controls are imposed to preclude unsafe moderation levels.

Certified dry powders are also placed into drums fitted with neutron absorbers to preclude criticality if accidentally moderated.

14.3.4.3 Concentration Controls

Concentration limits are specified as not more than 50% of the minimum critical concentration.

The concentration assumed for analysis is typically higher than the maximum credible concentration. Concentration controls are ensured by process analysis (determine that unsafe concentrations are unlikely even at upset conditions) and by sampling/certification of the concentration before departing from a geometry-controlled vessel. Concentration-controlled containers are strictly controlled in designated areas.

14.3.4.4 Neutron Absorbers

Neutron absorbers are modeled assuming the most reactive credible conditions:

1. Lowest credible absorber concentration or less.

2. Most reactive credible combination of fissile geometry-fissile moderation-absorber geometry.

The continued presence of the absorber is periodically verified. Neutron absorbers are typically used to ensure safety at one or more improbable accident conditions rather than to ensure safety at normal conditions.

14.4 Fixed Poisons

Fixed poisons are typically used as a secondary control as described in Section 14.3.4.4. The materials currently used are B_4C granules in cores of cylindrical geometries, boric acid in welded tubes for dry powder drums, and boral plates placed in finished bundle storage arrays.

All poisons are subjected to inspection to verify their presence.

14.5 Structural Integrity Policy and Review Program

All systems with potential criticality safety impact require an Engineering Change Notice (ECN) which requires approval by qualified persons responsible for engineering design, operations and safety (including criticality safety). Details are provided in Section 11.6.

14.6 Methods Validation

The methods employed in k_{eff} calculations, as described in Section 14.3.2, are used to model systems with a known k_{eff}. Data from critical experiments are readily available. Results from other's calculations of these systems are also available. Thus, results may be compared with the measured values and with other independent calculations.

The benchmark to be calculated is selected as being as close as practical to the actual system to be analyzed. Selection factors include enrichment, heterogeneity, moderation, dimensions, reflectors, arrangement of units, and neutron absorber effects.

These benchmarks are used to establish the systematic bias and its uncertainty as described in Section 4.2.2.

Documents such as UCRL-53369[4] and ANS Transactions are consulted for critical experiment references.

Each of the functional modules in SCALE, such as KENO-IV, XSDRNPM, NITAWL and BONAMI, are supplied with sample problems and their solutions by code custodians at ORNL. These sample problems are also calculated to verify proper implementation of the codes and cross sections.

Examples of the more often used data are given below.

14.6.1 Well-Moderated Homogeneous Systems

Report Y-1948[5] contains data and calculations (with Hansen-Roach cross sections) for 40 critical experiments.

The Exxon Nuclear replicates of these calculations are statistically identical to those in the report.

There are indications that the Hansen-Roach results tend to be biased high (conservative) at lower H/U's with a trend toward slightly nonconservative biases with increasing H/U.

The data in documents such as ARH-600 may also be used for comparison of k-inf, minimum critical mass, and critical dimension calculations. However, these data are calculation results rather than experimental data.

14.6.2 Undermoderated Homogeneous Systems

A series of experiments with interstitially moderated cans of damp (H/U = 0.77 or 2.03) U_3O_8 are documented in NUREG/CR-1071[6] and NUREG/CR-2500[7]. The effect of interstitial neutron absorbers such as steel and polyvinyl chloride (PVC) were included in these experiments.

The Exxon Nuclear calculated k_{eff} values are typically conservative by at least 0.01-0.02 in k_{eff} using Hansen-Roach, 27 group ENDF/B-IV, or 123 GAM-THERMOS cross sections.

14.6.3 Heterogeneous Systems

Report BAW-1484-7[8] contains data for a 3x3 array of bundles with various bundle-bundle spacings and with/without between-bundle neutron absorbers.

The KENO-IV results with Hansen-Roach cross sections yield accurate results. The 123 group GAM-THERMOS cross sections appear to yield accurate results for small bundle-bundle spacings but slightly nonconservative results at larger spacings.

The neutron absorber effects appear to be conservatively estimated using either cross section library. The benchmarking of these experiments with 27 group cross sections has not been completed at Exxon Nuclear.

The critical experiments in References 9 and 10 have been modeled. The KENO results are typically either slightly conservative or without significant systematic bias.

14.7 References

(1) "SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation," NUREG/CR-0200.

(2) H. K. Clark, "Critical and Safe Masses and Dimensions of Lattices of U and UO_2 Rods in Water," DP-1014.

(3) R. D. Carter, G. R. Kiel and K. R. Ridgway, "Criticality Handbook," ARH-600.

(4) B. L. Koponen and V. E. Hampel, "Nuclear Criticality Safety Experiments, Calculations and Analyses - 1958 to 1982," UCRL-53369.

(5) G. R. Handley and C. M. Hopper, "Validation of the "KENO" Code for Nuclear Criticality Safety Calculations of Moderated, Low-Enriched Uranium Systems," Y-1948.

(6) R. E. Rothe, et. al., "Critical Experiments with Interstitially-Moderated Arrays of Low-Enriched Uranium Oxide," NUREG/CR-1071, RFP-3008.

(7) R. E. Rothe and G. R. Goebel, "Critical Experiments on Low-Enriched Uranium Oxide Systems with H/U = 2.03," NUREG/CR-2500, RFP-3277.

(8) M. N. Baldwin, "Critical Experiments Supporting Close Proximity Storage of Power Reactor Fuel," BAW-1484-7, July 1979.

(9) S. R. Bierman and E. D. Clayton, "Criticality Experiments with Subcritical Clusters of 2.35 wt% and 4.31 wt% U-235 Enriched UO_2 Rods in Water with Steel Reflecting Walls," NUREG/CR-1784 (PNL-3602), January 1981.

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CHAPTER 15

PROCESS DESCRIPTION AND SAFETY ANALYSIS

CHAPTER 15 PROCESS DESCRIPTION AND SAFETY ANALYSIS

In the uranium oxide fuel manufacturing process described below, a number of techniques are employed throughout the plant to assure criticality safety. These include:

- The use of safe geometry, i.e., critically safe slabs and cylinders placed in arrays that limit interaction by separation;
- Limitations on the form and fissile content of the fuel being processed such as the 5 wt% U-235 limits in the UO_2 and Specialty Fuels Building;
- The use of mass control where a uranium processing vessel or container is limited to a safe batch not exceeding 45% of the minimum critical mass;
- Control of moderators as exemplified by the large batch uranium oxide blenders; and
- The use of neutron absorbers as in the case of the bundle storage array which utilizes Boral as a neutron absorber.

Any process or equipment which handles uranium in any form is carefully reviewed prior to startup to determine that the double contingency principle is met. Each review is then independently evaluated and periodic audits are conducted to determine that the equipment is materially unaltered, that practices are compatible with original operating assumptions, and that procedures are adhered to.

15.1 Conversion of UF_6 to UO_2

Gaseous UF_6 may be converted to uranium oxide through either of two processing routes: a wet "ADU" process, or a dry conversion process. In the former process, UF_6 is first contacted with water to form uranyl fluoride (UO_2F_2), reacted with ammonium hydroxide (NH_4OH) to produce ammonium diuranate (ADU) crystals, centrifuged and dried to remove liquids, and finally calcined in an hydrogen-nitrogen-steam atmosphere to convert the ADU solids to uranium oxide.

The dry conversion process route contrasts significantly from the ADU route in that UF_6 is reacted directly with hydrogen-nitrogen-steam atmosphere and calcined to form ceramic grade uranium oxide.

In both conversion processes, emphasis is placed on control and containment of the uranium-bearing materials, and on the industrial safety aspects of handling highly corrosive chemicals. A process off-gas system is provided to

treat fumes from the process, ventilated hoods are utilized around process equipment to control airborne uranium contamination, and the air in the chemical processing areas is changed out at frequent intervals by a once-through ventilation system.

15.1.1 Receipt and Storage of UF_6 Cylinders

Uranium feedstock enters the plant by truck in the form of uranium hexafluoride (UF_6), normally contained in Model 30 cylinders shipped in steel overpacks. Smaller cylinders may by used where quantities or enrichment dictate. Cylinders are unloaded by crane, weighed and stored in a safe array on a covered pad.

To assure criticality safety in conversion and subsequent processing, each numbered cylinder is checked for U-235 content using a gamma counter to verify the shipper's values. For cylinders containing greater than 4.5 wt% U-235, a UF_6 sample generated at the point where the cylinder is filled is analyzed using mass spectroscopy in the Exxon Nuclear laboratory.

15.1.2 Vaporization

After verification of enrichment, serial number, and cylinder weight to preclude heating an overfilled cylinder, UF_6 cylinders are moved by forklift and overhead monorail hoist to the vaporization facilities of the UO_2 Building. Once in the vaporization areas, ventilated to be the most negative zone of the building, a cold valve check is performed to evaluate the condition of the cylinder valve. If the cylinder is not found to be under negative pressure, it is evacuated and the valve is checked for leakage. A replacement valve is installed if a leak is indicated. UF_6 cylinders are then placed in electrically-heated, ventilated chests where they are connected to a welded, heated, and insulated stainless and monel header system used to transport UF_6 gas to the hydrolysis tank. A backup safety shutoff valve is installed next to the cylinder valve for added protection against uncontrolled release of gas from the cylinder. Prior to heatup of the cylinder, the header system is pressure-tested with dry nitrogen to check for leaks.

The vaporization chests, each limited to a single cylinder, are maintained slightly negative with respect to the surrounding room to contain any UF_6 leakage within the chest. Also, an emergency scrubber system is connected to the vaporization chests by ventilation ducting. The emergency system may be activated by emergency push buttons, mounted at the area exits, and alternatively from the conversion area control rooms located on the floor above the vaporization areas.

Activation of the emergency scrubber system causes the UF_6 vapor to be drawn into the scrubber, converted to uranyl fluoride by contact with water, and stored in critically safe tankage as uranyl fluoride (UO_2F_2) solution. This solution may then be processed via the standard ADU route. This safety system is tested at routine intervals to verify operability.

UF_6 cylinder temperature and pressure are carefully monitored and recorded during heatup and vaporization. In addition to separate control thermocouples, thermocouples are mounted on the skin of the UF_6 cylinder which activate a shunt trip breaker to shutdown chest heater power in case of an over-temperature condition. A separate backup infrared temperature sensing system also activates the shunt trip breakers to prevent cylinder overheating. Burnout of a thermocouple causes the control instrumentation to drive up-scale and safely shutdown cylinder heating.

As indicated above, the weight of each UF_6 cylinder is confirmed upon cylinder receipt to preclude rupture of an overfilled cylinder during the solid-to-liquid phase change and subsequent volume expansion which occurs during cylinder heating.

Personnel connecting and disconnecting UF_6 cylinders are required to use protective clothing including coveralls, rubber shoe coverings and plastic gloves. It is also a requirement that a full face mask, connected to an emergency breathing air supply, be worn when connecting and disconnecting cylinders. Separate self-contained breathing equipment and acid suits are available in case of emergency.

Safety protection for eyes is required at all times throughout the chemical areas.

15.1.3 Hydrolysis and Precipitation

In the wet route process, the UF_6 gas is contacted with water in an eductor nozzle and the resultant UO_2F_2 solution is collected in safe geometry cylindrical tanks. The UF_6 cylinders, which utilize moderation control as a criticality safety feature, are protected against accidental internal flooding from the hydrolysis system by a pressure control interlock system. A UF_6 flow control valve located between the hydrolysis tank and the UF_6 cylinder is automatically closed if the pressure in the UF_6 header drops to a preset pressure above the hydrolysis water supply pressure. This positive differential pressure protects against the flow of water or uranyl fluoride into the header piping and cylinder. Periodic tests are performed on this safety system to demonstrate its operability. A ventilated containment hood is provided over each hydrolysis tank to protect against small UF_6 gas leaks.

The uranyl fluoride produced in the hydrolysis system is mixed with ammonium hydroxide to produce ammonium diuranate precipitate (ADU). The precipitation tanks are critically safe by virtue of geometry and are vented to the process offgas system to prevent release of ammonia vapors to the operating area. Housekeeping is enforced to eliminate uranium solution spills which might dry and result in airborne contamination and safety showers are provided at strategic locations in the chemical area in case of operator contact with acid or caustic solutions.

15.1.4 Centrifugation, Drying and Calcination

Continuous centrifuges are used to separate solid ADU from the liquid stream. The solids are dried in a ventilated, oil-heated dryer, and the ammonia and water vapors are removed from the offgas stream by scrubbing in the process offgas system (POG). The high temperature silicone oil, used in the dryer as a heat exchange medium, is stable and not flammable at the ADU dryer operating temperatures. Dryer temperatures are automatically controlled and provision is made to protect against overheating of the oil by electrical shutdown of the oil heating system.

Dry ADU is fed from the dryer into a calciner through an enclosed feed chute to produce a dry uranium oxide product. Both ends of the rotating tube continuous calciner are vented by hoods attached to the calciner through rotating seals. The offgas from the calciner, which contains particulate uranium as well as fluorides, hydrogen, nitrogen and steam, is discharged through a liquid scrubber and is HEPA filtered along with the air from the calciner seal hoods.

The calciner, which operates at a slight negative pressure, is protected from the possibility of a hydrogen explosion by operation above the auto-ignition temperature of the gas. Nitrogen-purged rotary airlocks are used to discharge uranium oxide from the calciner and to control in-leakage of air.

15.1.5 Dry Conversion

The dry conversion process contacts a mixture of steam, nitrogen and hydrogen with vaporized UF_6 to form dry uranium oxide powder. The offgas stream containing excess steam, hydrogen, nitrogen and HF is treated by condensing and neutralizing the acid, scrubbing the noncondensible via the chemical area process offgas system scrubber, and then being exhausted through HEPA filters. This process is considered proprietary and is discussed, along with appropriate safety features, in documents referenced in Chapter 6.

15.1.6 Waste Handling

Effluent from the ADU centrifugation is treated by further processing through polishing centrifuges or filters followed by contact with an ion exchange resin bed before discharge from the UO_2 Building through a uranium sampler to the waste storage lagoon system. Criticality safety of the ion exchange columns is assured through use of a neutron absorber column in the center of each column. The B_4C absorber is inspected periodically to determine its condition and distribution.

15.2 Uranium Oxide Powder

Following the calcination operation, UO_2 powder is processed through a series of steps to enhance its sintering and pressing characteristics. These process steps, collectively termed "Powder Preparation", include blending, milling, compaction and granulation. Since uranium oxide at any of these steps contains varying quantities of finely divided particles, care is taken in the processing and handling to provide containment.

Containment is achieved through use of sealed equipment and through use of hoods and enclosures surrounding the equipment, where appropriate, which are connected to the exhaust ventilation system. The ventilation system is sized and designed to provide airflows through hood openings of 125 linear feet per minute or greater, and the air removed from the hoods is passed through HEPA filters prior to entering the main exhaust ductwork. Dampers are provided in the ducting to control the flow of exhaust air and to compensate for increased particulate loading in the HEPA and prefilters. Self-adjusting dampers are also incorporated in enclosure designs which allow continuous movement of air through these containment structures even with all doors and access openings closed. Hoods and enclosures are constructed of steel, aluminum, and impact-resistant, clear plastic to allow monitoring the process, where required, without opening the containment.

Also, uranium oxide powder is transported, processed and stored in sealed, dust-tight, metal containers which prevent release of airborne contamination and ingress of moisture and contaminants. Each container is identified by serial number and by content. The location and disposition of containers is carefully controlled to prevent inadvertent mixing in the process. Containers are generally of two types: 5-gallon pails which are limited to a single safe batch (45% of the minimum critical quantity), and 45-gallon drums which are used only for unmoderated materials and which contain a multi-pin neutron absorber structure to preclude any criticality incident.

The powder preparation operations are performed in controlled areas which are maintained negative to other operating areas and to the outside atmosphere. Personnel are required to wear protective clothing, including rubber shoe coverings, plastic gloves, coveralls, and eye protection while

operating or maintaining the equipment. Special non-routine circumstances may require limited use of respiratory protection as well. In addition, the surfaces of equipment and floors are checked at frequent intervals to monitor for buildup of contamination. Continuous air samplers are positioned at various locations around the equipment to detect airborne contamination. Hand, foot, and clothing surveys are conducted on exit from the uranium handling areas.

15.2.1 Powder Transport and Blending

Uranium oxide discharged from the calciners is transported to one of a series of critically safe (by geometry) slab hoppers via a negative pressure pneumatic transport system. The material is isolated in these slab hoppers located in a designated moderated-material exclusion area until laboratory moisture analyses of representative powder samples indicate that the powder contains less than 10,000 ppm moisture. This material can then be handled as unmoderated or "dry" powder, and the hopper discharge isolation valves, which are under lock and key, are administratively released by supervisory personnel.

The dry powder may be transported to a large batch blender, again located in a moderator-exclusion area by negative pressure pneumatic conveying or by gravity discharge. Sources of moderation, such as hydrogenous lubricants, mop water, overhead liquid lines, and sprinkler systems, are excluded or strictly controlled in the area around the blenders.

15.2.2 Milling, Slugging and Granulation

Following the blending step, the powder is again pneumatically transported via a negative pressure conveying system to a hammermill feed hopper. Unmoderated powder is processed through an enclosed, ventilated hammermill-powder compactor and rotary screen granulator using a gravity cascade feed. The discharged powder, dry by virtue of its having entered the moderation-controlled preparation system at less than 10,000 ppm moisture, is then placed in 5-gallon pails or 45-gallon drums and transported to the powder storage facility.

15.2.3 Powder Storage

The powder storage facility contains an array of metal storage shelving designed to meet requirements of seismic zone II and is operated as a moderation-controlled area. Only uranium oxide analyzed as less than 10,000 ppm moisture or having a process source which excludes carryover of moisture, such as the high temperature scrap oxidation process, is stored in this facility. All process liquid lines are excluded from the area, and the building construction is such that flooding can occur only if the entire site floods. The containers are handled and stored on metal pallets in a fixed geometric array with a minimum of 15-inch vertical separation between containers.

15.3 Pelletizing

The prepared uranium powder is pressed into pellets, and sintered in high temperature hydrogen furnaces. These operations are followed by grinding outside diameters, pellet inspection and storage. The pelletizing operation is performed in a controlled area marked by limited access. This area is operated at a pressure slightly below atmospheric to preclude egress of airborne contamination, and extensive use is made of enclosures and hooding around process equipment to contain uranium oxide contamination. As described above, area personnel are required to wear protective clothing and eye protection while operating the equipment.

15.3.1 Lubricant Blending

Powder drums are moved by electric cart from the powder storage facility to the lube blending area. Here, the drums are placed in ventilated enclosures and the lids removed. Weighed quantities of lubricant and, as required, poreformer are added to each container. A special drum lid is fitted to each drum and the sealed container is loaded into a tumble mixer.

Following blending, the container is marked to show the quantity of lubricant added. The equivalent moisture content, including hydrogen contained in the lubricant and poreformer, remains below the 10,000 ppm level required for unmoderated powder. A conical adaptor, equipped with both valve and moisture-tight cover, is fitted to each drum inside an enclosure and the sealed container is moved to the pelletizing floor for pressing.

15.3.2 Pellet Pressing

As in the case of the lubricant blend area, the area surrounding the pellet presses is designated as a moderation-controlled zone. Overhead process liquid lines are isolated from the press area by sheet metal trays, and mop water, lubricants, and other hydrogen sources are strictly limited.

The drums are hoisted above the presses and a dust-tight connection is made between the drum and the flexible feed hose used to convey powder to the press feed hopper below. The upper portion of each press, as well as the feed hoppers, are enclosed in an exhaust hood providing protection for the press operator from airborne uranium oxide dust.

Pellets are discharged from the presses on enclosed metal conveyors and placed in refractory metal sintering boats using automatic boat loaders. These boats which are 3.6 inches in height for criticality control purposes are moved via roller conveyors to boat storage tables. The slab geometry and 15-inch vertical separation of the boat storage array provides the necessary criticality safety.

15.3.3 Pellet Sintering

Pellet boats are stoked one high into electrically-heated, hydrogen-nitrogen atmosphere, sintering furnaces. The safe slab geometry is maintained through the furnace. Tri-level safe slab storage is used for the boats of pellets exiting the furnaces.

15.3.4 Pellet Grinding

Pellets are removed from refractory metal boats by upending into a hooded vibratory feeder bowl which has the geometry of a safe slab. The grinders which are also equipped with ventilated enclosures, size the pellets to final diameter. The pellets then are water-washed to remove grinding dust, dried on a moving belt conveyor, and inspected for dimensions and flaws. The acceptable pellets are loaded onto open metal trays, stacked, and weighed for storage.

Finely divided UO_2 from the grinding operation is caught in the grinder coolant and is removed as a wet cake by means of a centrifuge. The centrifuge and associated tank are critically safe by virtue of safe geometry. The UO_2 cake is dried in a ventilated oven and removed from the centrifuge bowl in a hood attached to the bowl drying oven. All scrap pellets and dried sludge from grinding are weighed and handled in sealed 5-gallon metal pails in safe batch quantities.

15.3.5 Pellet Storage

Trays of finished pellets are stacked ten high and placed three stacks to a metal pallet. Side-to-side separation between trays on the pallets is maintained by metal spacers welded to the tops of each pallet and loaded pallets are stacked in open metal racks which maintain physical separation between pallets side-to-side, as well as vertically. Criticality safety is provided by this physical separation and by the presence of the stainless steel storage trays interspersed through the layers of pellets.

The storage system has been designed to meet seismic zone II requirements.

15.4 Rod Fabrication

Fabrication of uranium fuel rods requires various processing and inspection steps including outgassing, loading, welding, leak check, assay, x-raying, etching, autoclaving, final inspection and storage. Because of the form of the uranium oxide (i.e., large ceramic pellets), hooding and special ventilation is required for only the first process steps, outgassing and loading.

15.4.1 Pellet Outgassing and Storage

Stacks of pellet trays are moved from the storage area to the outgas furnaces on roller conveyors which have provisions to contain any chips or contamination which may be on the trays. The tray stacks are processed through the hydrogen-nitrogen atmosphere, roller hearth furnaces in a geometrically safety end-to-end array. Gases from the furnaces are discharged to the building exhaust system after HEPA filtration and the room and ductwork are continuously monitored for hydrogen buildup.

Outgassed pellets are stored in an enclosed storage cabinet to provide a queue ahead of the rod loading operation. Criticality safety is achieved by storage in a fixed array with side-to-side and top-to-bottom separation maintained between tray stacks.

Special protective clothing, with exception of gloves, is not required in this and subsequent processing areas. Monitoring of equipment surfaces and the floor is performed to detect contamination. In addition, air samplers are located throughout the area to detect any airborne contamination.

15.4.2 Rod Loading

Ventilated, HEPA filtered boxes are used for containment during the rod loading operation. An end-to-end, single line fixed array is used in the loading boxes to assure criticality safety. The use of negative pressure relative to the outside assures containment of any uranium oxide dust generated during loading within the box. No special protective clothing is required. HEPA filtered exhaust is provided in the rod fabrication area to maintain the area negative with respect to atmosphere.

15.4.3 Rod Welding

Following loading, rods are moved to the adjacent welding stations. The rods are maintained in a single layer array to provide a slab of critically safe dimensions. The rod ends are decontaminated and the final weld is made, sealing all uranium materials within the rods. Rods are placed in metal trays having a depth of less than 3.5 inches to provide critically safe slab geometry during transport and storage.

15.4.4 Rod Leak Check

Rods are placed in the leak check chamber, one tray at a time. Safe slab geometry is achieved by limitation of the tray to 3.5 inches depth.

15.4.5 Rod Assay and X-Ray

Rods are removed from trays and processed individually through the rod assay station. The discharge from this station which acts as a feed queue for the x-ray station is in the form of a single layer of rods. Rods discharged from x-ray are collected in a single metal tray. Thus, the criticality safety of both work stations is assured by maintenance of a safe geometry slab of less than 3.5 inches.

Both the assay system, and the x-ray machines, are potential sources of radiation and are heavily shielded with lead encased in steel. Operator access to the machine internals, and thus to accidental exposure to radiation, is limited in the case of the assay equipment by the size and location of the rod entry and exit ports. Where the operator must regularly have access to the inside of the x-ray machine to change film and perform other tasks, access doors are electrically interlocked to prevent operation of the x-ray with the access door open.

A second x-ray unit, configured as a walk-in booth, is housed in a lead-lined, steel enclosure with a powered sliding door. Warning lights and interlocks between the door and the x-ray head are provided to prevent accidental exposure to personnel.

15.4.6 Rod Cleaning and Etching

Following NDT, the fuel rods are transferred in trays to storage. Trays are stored on enclosed conveyors which maintain the fuel in a series of geometrically safe slabs separated at vertical intervals of 15 inches.

Rods are removed from these trays and transferred to the etch room or bundle assembly by cart. Criticality safety in this area is by batch control which is achieved by limiting the number of rods in the area.

The etch room is equipped with a separate offgas scrubber and filter system used to treat any fumes given off by the hydrofluoric acid etch solution and stop etch bath. Special protection is provided for the operator including rubber gloves, face shield, and rubber apron.

15.4.7 Rod Autoclaving

Rods discharged from the etch room are loaded into autoclave baskets. These stainless steel baskets limit the fuel rods within a 10-inch diameter circle.

A monorail system is used to transport loaded baskets from the loading station to a storage rack. This structure, designed for seismic zone II, maintains the baskets in a fixed array to prevent a critical interaction between the baskets.

A single loaded basket is positioned in each autoclave by means of an overhead hoist which interfaces with the basket storage array. The rods are subjected to a high pressure, high temperature steam cycle. Both temperature and pressure are automatically controlled and carefully monitored to assure that the autoclaves are operated within nameplate limits. Rupture discs are provided along with an over-temperature shutdown for each autoclave for protection in case of control failure.

15.4.8 Final Rod Inspection

Baskets of autoclaved rods are moved from the storage array to final inspection. Here, the rods are removed from the basket in groups of approximately 50 and positioned in a plane array for inspection. Following inspection, the rods are loaded in metal storage trays and moved by roller conveyor to final storage. The use of safe geometry slab configuration is used at this work station to assure criticality safety.

15.4.9 Final Rod Storage

Fuel rods are stored in metal trays in an enclosed storage array to await release for the bundle assembly operation. This array is in the form of a series of safe geometry slabs separated by a vertical distance of 15 inches.

15.4.10 Rod Downloading

A special facility is provided in the rod loading area to allow downloading of rods.

The uranium from rods is recovered by removing an end cap and dumping the pellets into a 5-gallon metal pail within a hood for return to the scrap recovery operation. The hood is exhausted through a HEPA filter and air sample heads are located at this station to monitor for airborne contamination.

Protective clothing, gloves, and shoe covers are required while working in the downloading station, and survey equipment is located at its exit.

Safe slab geometry is used to maintain a critically safe work station, and pellet containers are limited to safe batch quantities.

15.5 Neutron Absorber Fuel Rod Fabrication

In order to preclude the possibility of accidental mixing of fuel containing gadolinia or boron with standard uranium oxide fuel, neutron absorber fabrication (NAF) is performed in a separate facility within the Specialty Fuels (SF) Building.

For preparation of gadolinia-uranium pellets, UO_2 powder is transferred to the NAF area in 45-gallon drums and off-loaded into a blender where the gadolinia powder is added. The blended powder is then milled, compacted, granulated, lubricated, and pressed into pellets. Each pellet has a special gadolinia marking to distinguish it from standard pellets.

Following the pelletizing operation, carefully identified boats of pellets are transferred by enclosed cart to the UO_2 Building sintering area. The boats are then batched through a selected sintering furnace, immediately removed from the furnace area, and returned to the NAF facility. The pellets are then ground in the NAF grinder, outgassed, loaded into rods, and seal welded.

After a check for contamination, the rods are transferred to the UO_2 Building by cart where these rods join the processing of standard UO_2 rods at the leak check work station.

The processes, equipment and controls used in the NAF facility are similar to those previously described for these operations in the UO_2 Building.

Criticality safety is assured in the NAF facility using a combination of moderation control, safe slab geometry, safe geometry arrays, and safe batch control.

B_4C-Al_2O_3 rods are fabricated completely within the SF Building (location of the NAF area). Pellets fabricated off-site are outgassed, loaded in rods, and seal welded before being moved to the UO_2 Building for inspection and assembly.

15.6 Bundle Assembly

The bundle assembly operation is comprised of several operations, rod picking, assembly, inspection cleaning, storage and packing.

15.6.1 Rod Picking and Assembly

Rod trays are removed from final storage and placed on an order picker. The order picker maintains two layers of rod trays in safe geometry slabs, separated by 15 inches vertical spacing. The order picker is used to deliver rods in the required sequence for assembly into bundles. A powered X-Y table is then used to insert rods into the fuel bundle being fabricated.

15.6.2 Inspection, Cleaning and Packaging

After a bundle is assembled, it is inspected, cleaned by washing if warranted, and dried with warm air.

A protective plastic sleeve is placed around each completed bundle and it is moved to storage or to the packaging station. In contrast to the rest of the assembly area which relies on the limited quantity, spacing and enrichment of the UO_2 fuel present to assure criticality safety, the bundle storage array makes use of neutron absorber (Boral) sheets to minimize the interaction between fuel assemblies.

During packaging, fuel assemblies are placed into inner shipping containers in a vertical position. These are then lowered into a horizontal position inside the outer shipping container. Sealed, loaded outer containers are removed from the building using a forklift and taken to the shipping/storage area.

15.7 Scrap Recovery

Scrap UO_2 powder and pellets are recovered by two routes, one dry and one wet. In each case, the initial processing step is oxidation of the UO_2 to U_3O_8.

15.7.1 U_3O_8 Facility

Scrap uranium oxide enters the U_3O_8 facility in either pellet or powder form in 5-gallon pails. Each bucket is limited to a single safe batch and must be certified dry (less than or equal to 10,000 ppm moisture).

The scrap is removed from the buckets inside of hoods, placed in metal trays (limited to a single safe batch), and oxidized in high temperature furnaces. Care is taken to avoid enrichment mixing. The U_3O_8 produced is then screened to remove klinkers and gravity discharged into a 45-gallon powder container or into a 5-gallon bucket. Since the material is dry entering the U_3O_8 facility and is processed through a furnace, no further moisture analysis is required.

Powder drums are weighed, blended and sampled to verify purity and enrichment as required for further processing steps and identified as dry powder.

In addition to the use of ventilated hoods mentioned above, personnel are required to utilize protective clothing including coveralls, rubber shoe covers, plastic gloves, and eye protection.

15.7.2 UNH Facility

Oxidized scrap powder which is not dry blended with virgin powder may be processed through the UNH facility. In this facility, uranium oxide is pneumatically transported from drums or buckets using a negative pressure conveying system to powder receivers located above each dissolver. The powder receivers are limited in volume and operate in conjunction with a scale system to control the quantity of powder batched into the dissolvers to assure criticality safety.

A nitric acid/water mixture is heated in the dissolver and pumped over the uranium oxide powder, held in a perforated metal basket until the oxide is dissolved. The basket is inspected between batches for undissolved uranium oxide to avoid buildup of material in the dissolver. Tank geometry and placement is carefully controlled to assure criticality safety within the UNH facility.

The uranyl nitrate is filtered and pumped to geometrically safe storage tanks where it is held until processed through a uranium conversion line.

Protective clothing and eye protection is required in this operating area. Exhaust from the dissolver feed hoods is HEPA filtered before leaving the area and the offgas from the dissolvers is treated through a multi-stage liquid scrubber to remove NO_x prior to HEPA filtration.

15.7.3 Scrap Recovery Area

Where scrap is not of acceptable purity to rejoin the virgin uranium oxide processing stream, the material may be processed through the Scrap Recovery Area. This facility has provisions for dissolving uranium oxide and purifying it through use of a solvent extraction system. The clean UNH from this operation is then reacted with aqueous ammonia to form ammonium diuranate. The precipitate is then centrifuged, dried, and calcined to UO_2, all within the Scrap Recovery Facility.

As in the case of the UNH Facility discussed above, criticality safety is assured in the Scrap Recovery Area through control of equipment and tank locations and geometry. Batching of the dissolver is strictly controlled, and

product UO_2 is handled only in safe batches. Both the hooding and process equipment are exhausted through HEPA filters, and protective clothing and eye protection are required for operating personnel safety.

15.7.4 Gadolinia Scrap Recovery

A separate facility is provided in the ELO Building for recovery of gadolinia scrap from the NAF operation. This facility, equipped with a dissolver, filtration equipment, and solvent extraction system, produces gadolinia-free uranyl nitrate. The uranyl nitrate may be converted to UO_2 in the Scrap Recovery Area or in either conversion line.

Criticality safety in the gadolinia recovery facility is provided by control of the geometry of the solvent extraction equipment and the dissolver as well as through control of feed and product solution uranium concentration (mass). A HEPA filtered exhaust hood is provided around the dissolver and protective clothing and eye protection are required for personnel operating in the area. Survey equipment is provided at the exit of this area to monitor hands, clothing, and feet on egress.

CHAPTER 16

ACCIDENT ANALYSES

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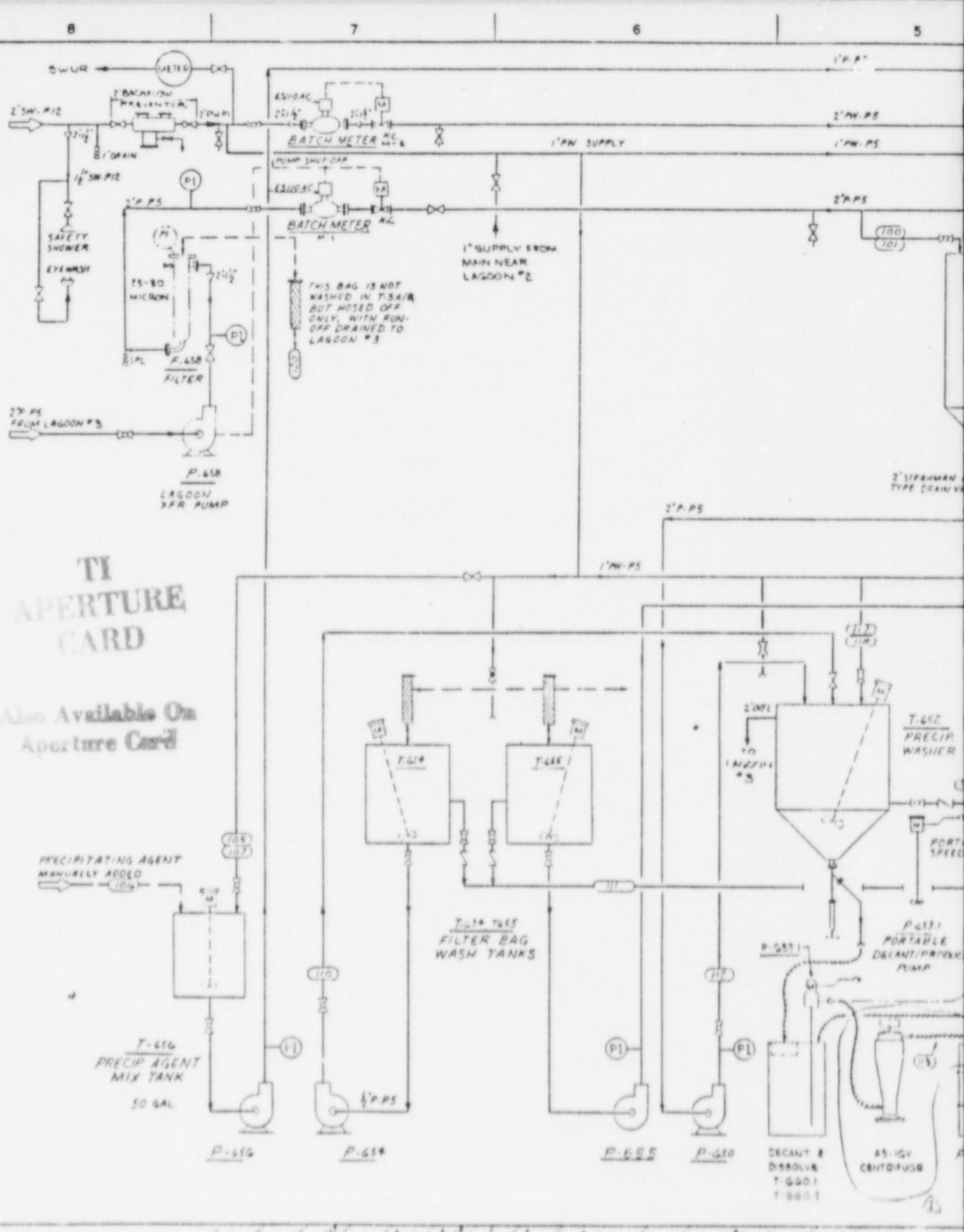
Fabrication of light water reactor fuel from slightly enriched UO_2 does not inherently involve undue risks to the public. However, as in all work with fissile or radioactive material, the potential (albeit low) exists for personal injury or even death to employees, and special care beyond normal industrial safety practices is required in design, construction, operation, and maintenance of facilities using radioactive or fissile materials. The Exxon Nuclear fuel fabrication facility has been designed with numerous safeguards against the inadvertent release of radioactive material to the surrounding environs and these have been discussed throughout this license application. Despite these safeguards, it is prudent to consider the consequences of off-standard or accident conditions both as an aid in emergency planning and as quantitative assessment of the degree of safety in the plant.

The types of accidents considered and their potential impact on occupational safety and the environment have been summarized in the Exxon Nuclear Plant Emergency and Radiological Contingency Plan. This plan has previously been submitted to the NRC as referenced in Chapter 8 of this application.



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		FEED STOCK SOLUTION #3		PRECIP SOLUTION #657		PRECIP REAGENT SOLUTION ADD	PRECIP REAGENT MAKE UP WATER		PRECIP REACT	FILTER & WASH PRECIPITATOR SLURRY TRANSFER		FILTER PRESS SLURRY	FILTER PRESS FILTRATE	PRECIPITATOR SLURRY	PRODUCT LOAD OUT	PRODUCT RECYCLE		RUN ADDITION	FILTER WATER WASH	
PER PRECIPITATION	NO OF UNITS	1		1		1	1	1	1											
	POUNDS					50														
	GALLONS	~4844		4500#		100	50		50				60							
	GPM	50		50		5	10		10				5							
	U Pu	~7.8		~				50					TRACE							
PER BATCH	NO OF UNITS	4		4		4	4	4	4	1		1	3	1	1	1	1		1	1
	GALLONS	~4574		~3794		400	200	4	200	20		80	180	~270	~50	~30	~80		300	300
	GPM	50		50		5	10		10	10		5	5	~50	5	5	5		10	10
	U Pu	~31										~4.4	TRACE	30	30	TRACE				

XN-2, REVISION 13

FIGURE II-10.31

QTY	ITEM	DESCRIPTION	REMARKS

119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
				2	2			1									
				-0.2	-0.2			6.66 KG 60 -0.3									
	1 300 S TRACE	1 300 S TRACE	1 300 S TRACE	-9.2	-9.2	TRACE	TRACE	14.66 -1.2									

XN-606 943	0	(LAGOON) URANIUM RECOVERY SITE PLAN	
XN-606 944	0	(LAGOON) URANIUM RECOVERY EQUIPMENT REQT.	
XN-606 [illegible]	1	(LAGOON) URANIUM RECOVERY DEMONSTRATION	
DWG NO	REV	REFERENCE DRAWING TITLE	

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REV	DESCRIPTION
2	ADDED AB-IGV CENTRIFUGE
1	A/S BUILT

EXXON NUCLEAR COMPANY, Inc.
RICHLAND, WASHINGTON

ENGINEERING FLOW DIAGRAM
LAGOON URANIUM RECOVERY
PRODUCTION FACILITY

DRAWN BY J. HENDALL
J.F.A. 8-11-81
NONE

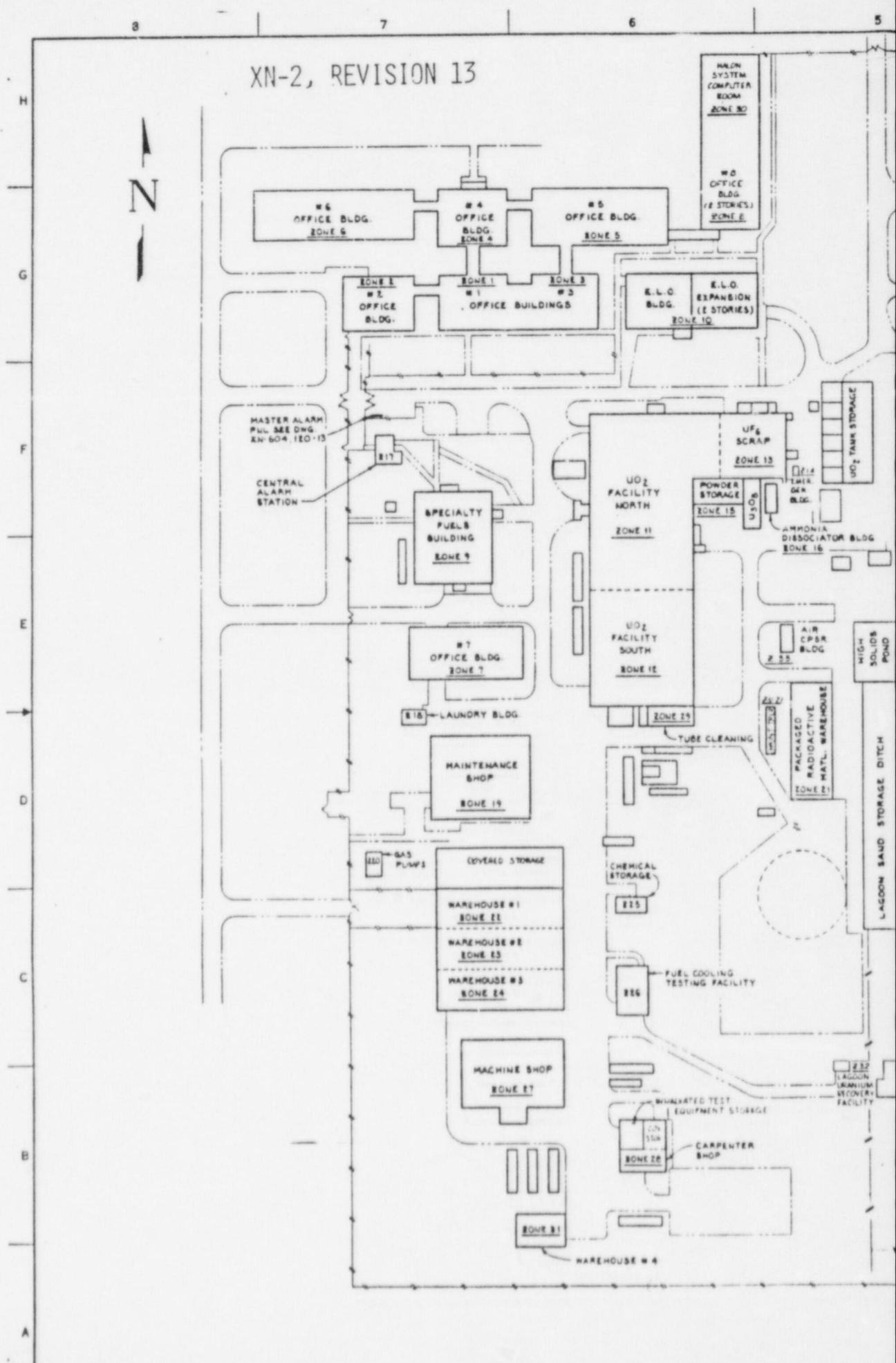
XN-606 943

DWG NO XN-606 943
REV 1 1 2

8609260255-32

ECN-1544

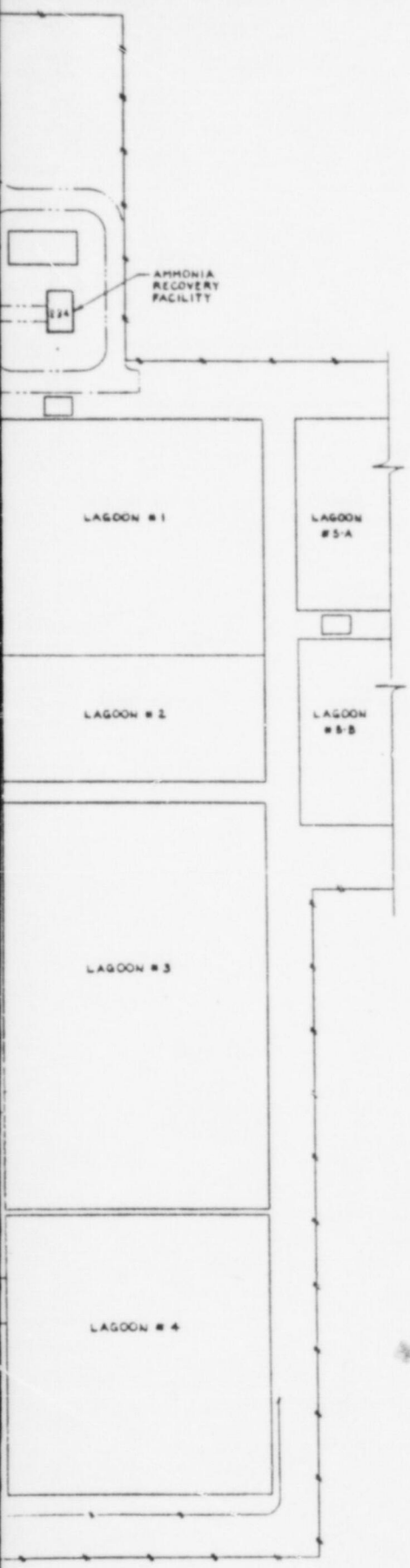
XN-2, REVISION 13



QTY	ITEM	DESCRIPTION	REMARKS

EXXON SITE FIRE ALARM SYSTEM DRAWING LIST

ZONE	DRAWING NO.	DRAWING TITLE
1 - 6	XN-606,747-SH 2 XN-606,747-SH 10	OFFICE BUILDINGS 1 THRU 6 HEAT DETECTOR & PULL STATION LOCATIONS " " " " " " CONFIGURES ELECTROMAGNETIC DOOR RELEASE LOCATIONS
7 & 8	XN-606,747-SH 8	OFFICE BUILDINGS 7 & 8 HEAT DETECTOR & PULL STATION LOCATIONS
9 & 10	XN-606,747-SH 4	S.F. & ELO BUILDINGS HEAT DETECTOR & PULL STATION LOCATIONS
11,12 & 13	XN-606,747-SH 6	UO_2 BUILDING HEAT DETECTOR & PULL STATION LOCATION
14	XN-606,747-SH 7	UO_2 EMERGENCY GENERATOR BUILDING HEAT DETECTOR & PULL STATION LOCATIONS
15	XN-606,747-SH 8	POWDER STORAGE, U308 & MAINTENANCE SHOP-HEAT DETECTOR & PULL STATION LOCATIONS
16	XN-602,604-SH 1 XN-606,747-SH 6	AMMONIA DISSOCIATOR #1 #2 #3 & AMMONIA VAPORIZER ELEC. SCHEMATIC & DETAILS " " " " " " HEAT DETECTOR & PULL STATION LOCATION
17	XN-604,120-SH 1 XN-606,747-SH 6	CENTRAL ALARM STATION F.A. PLAN & EQUIPMENT LOCATION " " " " HEAT DETECTOR & PULL STATION LOCATION
18	3959-N135 XN-606,747-SH 6	CONTAMINATED CLOTHING CLEANING (LAUNDRY) " " " " HEAT DETECTOR & PULL STATION LOCATIONS
19	3959-N98 XN-606,747-SH 7	MAINTENANCE SHOP POWER, COMMUNICATIONS & ALARM PLAN & DETS " " " HEAT DETECTOR & PULL STATION LOCATIONS
20	3959-N137 XN-606,747-SH 7	GASOLINE DISPENSING SYSTEM (GAS PUMPS) " " " " " " HEAT DETECTOR & PULL STATION LOCATIONS
21	XN-605,288 XN-606,747-SH 6	RADIOACTIVE MATERIALS WAREHOUSE, PAINT TRAILOR " " " " " HEAT DETECTOR & PULL STATION LOCATIONS
22	3959-N85 XN-606,747-SH 7	WAREHOUSE #1 PANEL SCHEDULES, FIRE ALARM & COMMUNICATIONS PLAN " " HEAT DETECTOR & PULL STATION LOCATIONS
23	3959-N86 XN-606,747-SH 7	WAREHOUSE #2 LIGHTING, POWER, FIRE ALARM & COMMUNICATION PLAN " " HEAT DETECTOR & PULL STATION LOCATIONS
24	3959-N106 XN-606,747-SH 7	WAREHOUSE #3 LIGHTING, POWER, FIRE ALARM & COMMUNICATION PLAN " " HEAT DETECTOR & PULL STATION LOCATIONS
25	3959-N96 XN-606,747-SH 7	CHEMICAL STORAGE BUILDING PLAN, ELEVATIONS & DIAGRAMS " " " HEAT DETECTOR & PULL STATION LOCATIONS
26	3959-N84 XN-606,747-SH 7	PCTF BUILDING POWER, LIGHTING & RCPT PLANS " HEAT DETECTOR & PULL STATION LOCATIONS
27	3959-N98 XN-606,747-SH 6	MACHINE SHOP POWER, COMMUNICATION & ALARM PLANS " " HEAT DETECTOR & PULL STATION LOCATIONS
28	3959-N130 XN-606,747-SH 6	I.T.E.S. & CARPENTER SHOP POWER PLAN " " " " HEAT DETECTOR & PULL STATION LOCATIONS
29	XN-606,747 SH 5	(TUBE CLEANING) UO_2 BUILDING
30	XN-606,747 SH 8 XN-606,747 SH 9	FIRE PROTECTION & ALARM DEV. LOC. COMPUTER ROOM OFFICE BLDG # 2 ALARM DETAILS - OFFICE BLDG #2
31	XN-606,567	WAREHOUSE # 4 (ZIMMER FUEL) ELECTRICAL PLAN
32	XN-606,747-SH 7 XN-606,755	" " " HEAT DETECTOR & PULL STATION LOCATIONS LAGOON URANIUM RECOVERY CHANGE ROOM
33	XN-606,747-SH 6 3959-N75 XN-606,747 SH 6	" " " HEAT DETECTOR & PULL STATION LOCATIONS AIR COMPRESSOR BLDG: LFG, NO 2 EXPANSION DETAILS & GUIDELINES " " " " HEAT DETECTOR & PULL STATION LOCATION
34	3959-N186 XN-606,747 SH 6	AMMONIA RECOVERY FACILITY ELECTRICAL PLAN " " " HEAT DETECTOR & PULL STATION LOCATION



NOTES

1. SEE DWG XN-606,590 FOR PLANS, EQUIPMENT ARRANGEMENT & DETAILS & WIRING FOR THE FOLLOWING AREAS: OFFICE BLDG # 1 EQPT ROOM # 118, UO_2 BLDG ROOM # 200 & S.F. BLDG ROOM # 228. SEE THIS DWG. FOR ROOM LOCATIONS.
2. SEE DWG XN-604,120 FOR THE FOLLOWING: SMOKE DETECTOR GRAPHIC PANEL, SMOKE DETECTOR ANNUNCIATOR, FIRE ALARM ZONE ANNUNCIATOR, & MASTER ALARM GRAPHIC PANEL.
3. FOR UNDERGROUND TRUNK PLAN & PULL BOX DETAILS SEE DWG. XN-603,783.

TI APERTURE CARD

Also Available On Aperture Card

8609260255-33

MODIFIED BY ECR No. 1526

APPROVED FOR CONSTRUCTION

DWG. NO.	REV	REFERENCE DRAWING TITLE

		ADDED SHEETS 6, 7, 8, 9 & 10 FIRE ALARM SYSTEM UPGRADE ADDED ECR 19-30-82-(3)
APPROVED	DATE	REVISION DESCRIPTION

DRAWN BY: T. LUZZO

DESIGNED BY: DATE: BY:

DRAWING BY: L.G. Bubb 9-8-84

SCALE: NONE

EXXON NUCLEAR COMPANY, Inc.

FIRE ALARM SYSTEM
SITE PLAN
DRAWING LIST
& BUILDING PLANS

DWG. NO. XN-606,747 REV. 1

SHT. NO. 1 SHTS. 10 REV. 1

FIGURE 11-10.32

APPENDIX A

CHAPTER 10

PROPERTY LOSS PREVENTION REPORT

M&M Protection Consultants

EXXON NUCLEAR COMPANY, INC.
2101 HORN RAPIDS ROAD
RICHLAND, WASHINGTON

INSPECTED BY: J. P. Abrenica
DATE: April 26 & 27, 1983